

Evaluation of the Necessity of CT Scan Requests in Hospitals Affiliated With Birjand University of Medical Sciences, Birjand, Iran, in 2019

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Abstract

Background: A computed tomography (CT) scan is one of the medical imaging methods that is currently used to diagnose and treat numerous diseases in a timely manner. Therefore, the widespread use of ionizing radiation in recent years has raised concerns about cancer. Given that individuals are exposed to ionizing radiation during a CT scan, they might be at a higher risk of developing cancer.

Objectives: This study aimed to evaluate the necessity of CT scan requests in hospitals affiliated with Birjand University of Medical Sciences, Birjand, Iran, in 2019.

Methods: The statistical population consisted of 1,034 patients, selected by purposive sampling and relevant statistical formula. Patients' information included gender, age, electronic code, and the imaged area. All the data were extracted by considering all ethical principles and recorded in prepared checklists. Additionally, the normality or abnormality of each CT scan was determined based on a radiologist's report. The obtained information was analyzed by SPSS software (version 22).

Results: Out of 1,034 patients, 547 (52.9%) and 487 (47.1%) subjects were female and male, respectively. The CT scans consisted of 687 (66.44%), 296 (28.62%), and 51 (4.93%) of the brain, abdomen-pelvis, and neck, respectively. The lowest and highest percentages of unnecessary cases belonged to the CT scans of the neck (31.37%) and brain (64.48%).

Conclusions: In all tests, 58.6% of CT scans performed on patients were unnecessary. In addition to high doses of radiation endangering the patient's health, these unnecessary procedures impose additional costs on the hospital and the patient.

Keywords: CT Scan; Necessity; Birjand

1. Background

A computed tomography (CT) scan is one of the medical imaging methods which is used to diagnose and treat numerous diseases in a timely manner. Low-quality radiographic images and, more importantly, superimposition or overlapping of various structures due to radiation at one angle were the important limitations of radiography, which are eliminated by CT scans and radiation at different angles. A CT scan can be used to diagnose neurological diseases (1), congenital diseases (2), brain strokes (1), and lung diseases (3).

The mechanism of CT scans for imaging the inside of the human body, similar to radiographic examinations, uses X-rays, which are a type of ionizing radiation. In routine mammography or radiographic test, relatively low levels of ionizing radiation are used. However, in CT scans, high-dose radiation is used as an effective factor in enhancing image quality. Research findings in the United States showed that the effective dose of a CT scan of the abdomen

and pelvis is 7.7 mSv, equivalent to the dose of background radiation, which each person receives through natural radioactive materials in a period of 2.6 years (4).

The widespread use of ionizing radiation in recent years has raised concerns about cancer. Given that nearly 70 million CT scans are performed annually in the United States, researchers estimated that the future 29,000 cancers could be related to CT scans performed in 2007 in the United States. The largest share was considered to be abdominal and pelvic CT scans (5).

Another study demonstrated that there might be as high as one fatal cancer for every 1,000 CT scans performed in young children (6). This problem is exacerbated when ionizing radiation comes in direct or indirect contact with sensitive points, including the thyroid or gonads. Researchers have concluded that the thyroid gland, contacted with X-rays, is highly susceptible to cancer and that high-dose ionizing radiation is the most effective factor in



causing this type of cancer (7).

2. Objectives

Due to the high number of CT scan requests and the resulting damages, which were mentioned earlier, this study aimed to evaluate the necessity of CT scan requests in hospitals affiliated with Birjand University of Medical Sciences, Birjand, Iran, in 2019.

3. Methods

This descriptive-analytical study was performed to evaluate the necessity of CT scan requests in patients referred to the CT scan wards of hospitals affiliated with Birjand University of Medical Sciences. A total of 1,034 patients were studied. Sampling was performed using the Krejcie and Morgan Sampling Method.

Patients' information included gender, age, electronic code, and the imaged area. All the data were extracted by considering all ethical principles and recorded in prepared checklists. In addition, the normality or abnormality of each CT scan was determined based on a radiologist's report. Finally, the obtained information was analyzed by

SPSS software (version 22).

The number of negative reports (i.e., the absence of abnormalities in CT scans) for various tests, including the brain, abdomen, pelvis, and neck, in both male and female subjects, was divided into the total number of each test that determined the necessary and unnecessary items in the tests performed.

In the present study, the patients' information who had various CT scans in the past was used, and no CT scans were performed as an intervention. In addition, the information collection process did not interfere with other activities of the department.

4. Results

In the present study, 1,034 images were examined. Of all these patients, 487 (47.1%) and 547 (9.52%) subjects were male and female, respectively. The patients' age was within a range of 1 - 97 years. Table 1 provides information about patients by the type of test, with the least and most unnecessary cases belonging to the CT scans of the neck (31.37%) and brain (64.48%). Table 2 shows patients' information by age group.

Table 1. Patients' Information by Computed Tomography Scan Areas

CT scan area	Necessary, No. (%)	Unnecessary, No. (%)	Total
Brain	244 (35.51)	433 (64.48)	687
Abdomen and pelvis	149 (50.33)	147 (49.66)	296
Neck	35 (38.62)	16 (32.37)	51
Total	428 (41.93)	606 (58.60)	1034

Abbreviation: CT, computed tomography.

Table 2. Patients' Information by Age Group

Age Group, y	Necessary, No. (%)	Unnecessary, No. (%)	Total, No. (%)
1 - 14	16 (3.8)	44 (7.3)	60 (5.9)
15 - 24	23 (5.5)	73 (12.1)	96 (9.4)
25 - 44	107 (25.5)	188 (31.3)	295 (28.9)
45 - 64	136 (32.5)	156 (26)	292 (28.6)
> 65	137 (32.7)	140 (23.3)	277 (27.2)
Total	419 (100)	601 (100)	1020 (100)

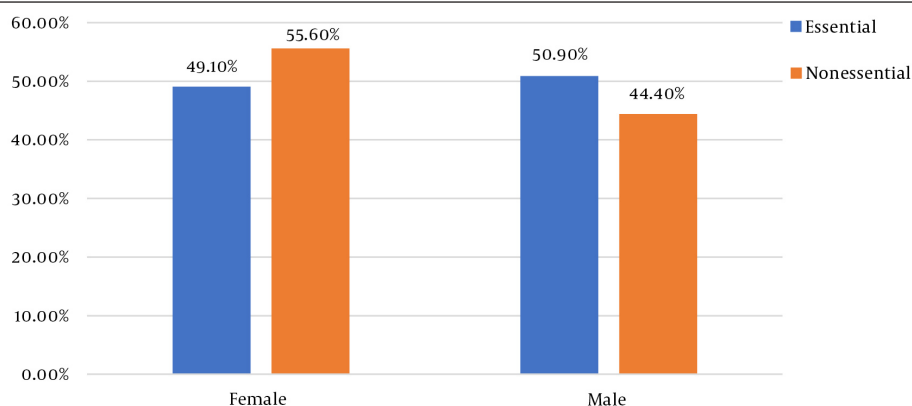


Figure 1. Patients' information by gender; out of 547 and 487 images of male and female subjects, 337 (55.6%) and 269 (44.4%) images as unnecessary, respectively, indicative of a higher percentage in female subjects.

5. Discussion

This study aimed to evaluate the necessity of CT scan requests, in which 606 (54.60%) of 1,034 CT scan images were normal (with no medical problem). The highest percentage of normal cases belonged to brain images (64.48%).

The results of the present study, in terms of the percentage of normal images, were at a moderate level, compared to other studies; accordingly, the results were higher than some and lower than other studies. In the present study, the percentage of normal images was 58.60%. However, in a study conducted by Giannitto et al. that evaluated the appropriateness of each CT phase of 76 female patients on the basis of clinical indications, they reached the conclusion that 93 (47%) out of 197 CT phases with an average of 2.6 phases per patient were unindicated (8).

In another study conducted in 18 countries, the percentages of the unnecessary chest and abdomen-pelvis CT scans were 100% and 65%, respectively (9). Furthermore, in the present study, the largest number of unnecessary CT scans belonged to the brain, which indicates an increasing demand for brain CT scans. In this regard, a study conducted by Pearce et al. on the trend and pattern of CT scan requests over a period of 10 years concluded that 70% of CT scan requests were related to the brain (10).

In addition, the present results showed that the most and the least unnecessary cases of requesting CT scans by age group were related to the age groups of 25 - 44 (31.3%) and 1 - 14 (7.3%) years, respectively. According to the fact that radiation is more harmful to children, these results might not sound alarming. Nevertheless, a study by Shuryak et al. concluded that radiation carcinogenesis becomes increasingly important with age, and the risks of radiation-induced cancer in middle age might be up to twice as high as previous estimations, which raises higher risks for occupational radiation exposure and radiological imaging (11).

The results of this study in terms of gender are not consistent with the results of other studies in this regard. Al-Ryalat's study and another study showed that the CT scans' frequency in male patients is significantly higher than in female patients, and the reason was more activity of male subjects in various fields. It has been reported that this inconsistency in results might be due to the conduct of these studies in the hospital emergency department (12).

The dose of CT scan is significantly higher than other modalities. According to the International Commission on Radiological Protection, the effective dose for the head CT scan is 2 mSv, and for the abdomen and pelvis is 10 - 20 mSv, which in plain radiographs is 0.07 and 0.7 mSv, respectively (13). Therefore, it is imperative to pay attention to the necessity of a CT scan request. A study conducted in an Iranian hospital showed that 60% of CT scan requests were for documentation for response to legal authorities, and only 17.6% were at the request of the chief physician.

Furthermore, another study in Australia demonstrated that healthcare-related reforms and laws had a significant effect on reducing or increasing CT scan requests (14). Another reason could be the patient's belief or insistence on doing the imaging (15).

5.1. Conclusions

The CT scan plays an important role in diagnosis. Nevertheless, the present study showed that more than half of CT scans performed are unnecessary, which can lead to high doses of radiation and additional costs for the hospital and the patient. The lack of a precise framework for this procedure leads to an exorbitant increase in these requests. It is suggested to establish stricter rules to prevent patients from being unnecessarily exposed to high doses of radiation.

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