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To Determine the Frequency of Unnecessary Computed Tomography Scan Occuring in a Tertiary Care Hospital

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Abstract: CT scan is a revolutionized diagnostic imaging modality that allows three-dimensional visualization of a region of the body in different planes. Besides its advantages, CT has disadvantages as well. The radiations used in CT scans are ionizing X-ray radiations which increase the risk of cancer progression. The rate of unnecessary CT scans has increased over the past few years which has resulted in increased exposure to the patient and increased healthcare cost as well. The aim of this study was to determine the actual rate of unnecessary CT scans in a tertiary care hospital of our country. The study was conducted on 385 patients in the Aziz Bhatti Shaheed Teaching Hospital, Gujrat in time duration of three months. It was an observational cross-sectional study. Scoring of the results was done by the co-supervisor having an experience of over 15 years. The scoring system was categorized from score 0 to score 2.Score 0 had no pathological finding, score 1 had suspicious finding and score 2 had confirmed pathological finding mentioned in the request form. A total of 385 patients were included in this research 162 females (42.1%) and 223 males(57.9%) with a mean age of 38.2±22.5-year (1-100 years).In this study 147 patients(38.2%) were categorized underscore 0 they were having no pathological finding and their results were normal,25 patients(6.5%) were categorized underscore 1 they had suspicious findings and were considered for follow up scan and the remaining 213(55.3%) patients were categorized underscore 2 they had confirmed pathology. Results concluded that the rate of unnecessary CT scans performed in this country is 38.2% which is considerably high. Unnecessary CT scans can lead to the risk of developing contrast-induced nephropathy (CIN) due to radiation exposure. The high cost of this test may cause a delay in the treatment of the patients.

Keywords: Frequency, Computed Tomography Scan, Contrast-Induced Nephropathy, Patients.

INTRODUCTION

With the advent of computed tomography (CT), the diagnostic radiology has revolutionized [1]. Computed Tomography is a computerized technology that allows rapid formation of 3D imaging providing cross-sectional information about a structure revealing the minor details of the subject in a cut section in the form of slices because CT scan machine utilizes X-rays for producing images. CT scan helps to rule out any sort of disease related to either a bone or a soft tissue [2]. Many CT scans are carried out on the basis of the variable region of interest required. CT results in the production of using three-dimensional images of the body either in axial, coronal, lateral views that are demonstrated by a radiologist [3]. As with advancement CT is now also been used in musculoskeletal studies for the assessment of tumors, infections, traumatic injuries, before an operation and after operation evaluation of the extremities [4]. CT scan has resulted in better improvement in surgical interventions, better healing after trauma or injury as well as better management of stroke and cardiac conditions after diagnoses [5]. CT has shown its great impact on surgery it has reduced the overall emergency exploratory surgical rate from 5% to 13% [6].

As CT is a very useful modality for diagnostic purpose so it contributes a major role in the radiological department, but besides its vital role in diagnosis it is also very fatal and has disadvantages as it uses ionizing radiations (X-rays) and radiations used by CT are even more in amount than used in plain radiography. It's assumed that in the United States more than 62 million CT scans are performed annually of which 4 million CT scans includes scans of children. A single CT scan results in the exposure of 20mSv.The doses from a CT scan are considerably larger as compared to conventional radiographs an abdominal X-ray exam results in a much smaller dose of 0.25mGy to the stomach which is 50 times lesser as compared to

the CT dose to the stomach which is 10mGy.But as compared to X-rays CT results in a greater amount of radiation and thus has resulted in increased radiation exposure in population within the last two decades CT scans offer three-quarter of collective dose from high-dose procedures. The use of CT in the symptomatic patient include little risk factors thus providing better diagnosis, while the use of CT in asymptomatic patient contribute to high-risk factors [7]. As the excess of everything is harmful. The use of CT has been increased with time both in symptomatic as well as asymptomatic patients so the radiations being used are also increased which is a major source for many dreadful effects on a subject. Extensive use of CT will surely cause many public health issues in the future years. CT has both harmful and useful aspects, so whenever performing CT risks v/s benefits must be kept in mind. If the benefits are more remarkable that such a scan is useful and can be performed for better result but if the number of risks exceeds than that of benefits that such a scan is termed as "unnecessary scan "and contribute nothing for diagnostic purpose and are both wastages of time and money and is even harmful to a person due to its radiation. There are many other factors that contribute towards the unnecessary exposure such as If the patient is asymptomatic. The patient doesn't represent desirable symptoms to perform a CT scan, this case is more dreadful in a patient who is poor and can't afford such a scan [8]. If the technologist/technician is unable to appropriately position the patient and conducts out a poor quality CT scan then such a negligence of a technician will result in undesirable repeated CT examination of the patient thus resulting in unnecessary radiation exposure to the patient as well [9].

As with the increased use of CT, it has gained the concern of the people regarding its dose effect [10]. Exposure from high ionizing radiation is although rare there is a lot of high radiation in radiotherapy but repeated and low dose radiation has become very common over a period of 25 years [11]. As CT uses ionizing radiations even low dose radiation have considerable side effects causing solid organ cancer and leukaimia [12]. It is accepted that high doses of radiation will result in causing the risk of developing lifetime cancer. The link between the radiation and the cancer is largely based upon the data obtained through the studies of survivors of Japan bomb blast in 1945 [13] and also from the assessment of radiation risk in those people working in nuclear industry [14]. High radiation of CT especially contrasts CT results in undesirable effects such as; nephrogenic systematic fibrosis, contrast-induced nephropathy. The result is dreadful patient condition and comfort which ultimately leads to a long and time-consuming treatment of patient [15]. As CT scan uses X-rays unwanted CT results in DNA damage because X-rays results in ionization of DNA that ultimately leads to a mutation in genes. Human cells can repair a radiation damage but if the DNA breakage of double strands occurs then this results in abnormal gene fusion thus causing chromosomal abnormalities and initiating cancer in patients [16, 17]. Unnecessary CT scan can be controlled by modulations in the tube current and AEC which is a new technique which changes the tube current depending upon the region of the patient under examination and has resulted in the best optimum radiation dose to the patient [18].

MATERIALS AND METHODS

The study was conducted on 385 patients in the Aziz Bhatti Shaheed Hospital, Gujrat in time duration of three months. It was an observational cross-sectional study. Scoring of the results was done by the co-supervisor having an experience of over 15 years. The scoring system was categorized from score 0 to score 2. Score 0 had no pathological finding, score 1 had suspicious finding and score 2 had confirmed pathological finding mentioned in the request form. Equipment used was SIEMENS SOMATOM Sensation 16 CT scanner machine.

RESULTS

A total of 385 patients were included in this research 162 females (42.1%) and 223 males (57.9%) (Table-1) with a mean age of 38.2±22.5-year (1-100 years) (Table-2). The region of interest included abdomen with a frequency of n=23(6%), Brain scans were done more frequently accounting for n=340(88.3%), Chest scans with n=14(3.6%), foot scan with a frequency of n=2(0.5%), knee scan accounting for n=1(0.3%), Lumbar spine n=1(0.3%) and neck scans with a frequency of n=4(1%) respectively. Out of all the scans performed the results included were adenexal mass, ascites, bronchiectasis, hepatic nodule, hepatic cyst, infection, intestinal obstruction and meningioma all individually accounted for n=1(0.3%), atrophy n=8 (2.1%), contusion n=11(2.9%), fracture n=38 (9.9%), hematoma n=33 (8.6%), hemorrhage n=25 (6.5%) and infarction n=51(13.2%). Out of these 147 (38.2%), patients had normal CT scans with no pathological findings (Figure-1). The intravenous contrast was administered in 74 patients (19.2%) the remaining patients n=311(80.8%) had plain CT scans (Figure-2). The result of the CT exams was made considering the radiological findings in the form of scoring ranging from score 0-2. The score 0 was assigned to the patients who did not have any pathological findings and there CT scan results were normal. The score 1 was assigned to the patients who had suspicious findings. The score 2 included those patients who had a confirmed pathological finding with regards to the complaint mentioned in their CT request form. In this study 147 patients (38.2%) were categorized underscore 0 they were having no pathological finding and their results were normal,

25patients (6.5%) were categorized underscore 1 they had suspicious findings and were considered for follow up scan and the remaining 213(55.3%) patients were categorized underscore 2 they had confirmed pathology (Figure 3). A total of 74 patients had contrast administered CT scans out of 385 scans. Among which 47(63.5%) patients had normal contrast CT exam (score 0), 9(12.1%) patients had suspicious findings (score 1) and 18(24.4%) patients showed pathology after contrast administration (score 2) (Figure-3).

Table 1: Gender distribution of the patients undergone CT scan

GENDER				
	Frequency	Percent	Valid Percent	Cumulative Percent
Female	162	42.1	42.1	42.1
Male	223	57.9	57.9	100.0
Total	385	100.0	100.0	

Table-2: Mean with SD, Minimum & Maximum of Age

AGE						
	N	Range	Minimum	Maximum	Mean	Std.Deviation
Age	385	99.00	1.00	100.00	38.2597	22.54417

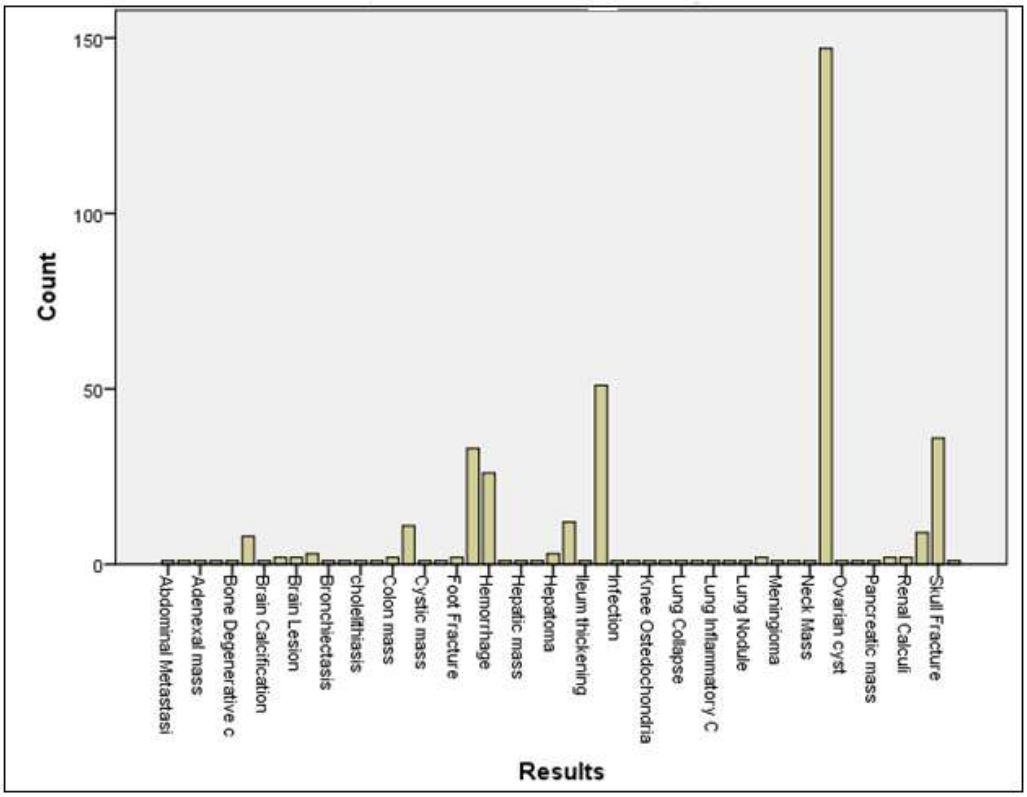

Fig-1: Results of the CT Scan examination performed

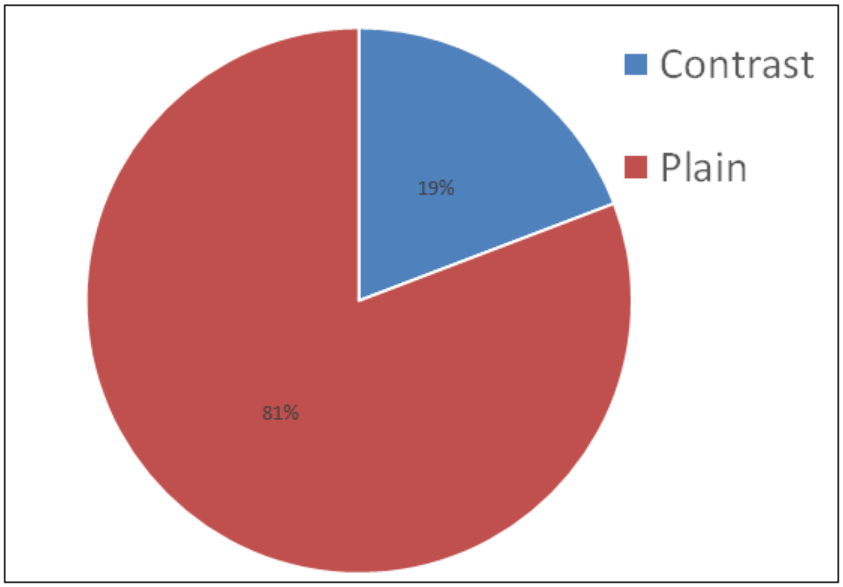

Fig-2: Graphical presentation showing frequency and percentages of contrast and plain scans

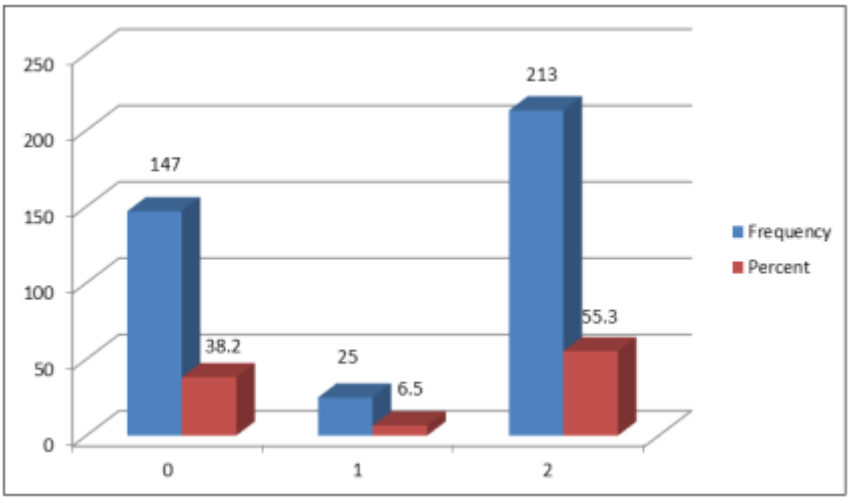

Fig-3: Graphical presentation showing the frequency and percentages of radiological scoring of the scans

DISCUSSION

The use of CT scan has been revolutionized over the passage of time as advances in diagnostic imaging have occurred. CT scan has been used due to fast scanning speed and greater detection of diseases which are more deeply situated. CT scan is best for visualization of bone scans. But as the use of CT scan has increased its drawback are also estimated by studies. The harmful effects caused by the radiations when exposed need to be considered [1]. Currently, CT scan is a large source of radiation ranging from 40% to 67% among other diagnostic imaging procedures [19]. The radiations used in a CT scan are strong electromagnetic ionizing radiation which results in more exposure to radiations as compared to a simple X-ray radiograph. The radiations can directly change the genetic makeup of a DNA strand by breaking the single or double strand of DNA or by causing damage to the base of the DNA causing the development of unwanted cancer[7]. It is important to reduce the rate of unnecessary CT scans to make the quality of healthcare better, to prevent the delay in treatment, to avoid the harmful effects of radiations and to avoid contrast-induced abnormalities [20]. The rate of unnecessary CT scans can be lowered by implementing radiation safety rules and keeping the dose as low as possible. Unwanted CT scan reduction will lower the health cost and improve the management of a patient. Arslonglu *et al*., mentioned in their research that it is very essential for the doctors as well as intern-doctor to have immense knowledge about the radiation effects caused by the exposure to the patient by ionizing radiations. This study showed that the doctors and intern-doctors were unaware of the effects caused by the radiation. So it is necessary that all doctors should have awareness about the radiation hazards and should be educated about the radiation protection [21].

As we consider our study the region most requested to be examined was the brain. According to our observation, the reason for ordering CT brain was a chronic headache, altered mental status, and protocol-based requests. It is the task of the neurologist and physician to carefully take patient history, check the patients for repeated scans and after how much duration they are having the scan [22].

It was an observational cross-sectional study. The aim of this research work was to observe the rate of unnecessary CT scan in a tertiary care hospital. In our country, Pakistan we are unaware of the rate of unnecessary CT scans been carried out. The research was done in the Aziz Bhatti Shaheed Teaching Hospital, Gujrat. The scoring of the results was done by a radiologist having an experience of over 15 years. In our study out of 147 patients who had unnecessary CT scan score 0(no pathological finding), n=47(63.5%) patients had unnecessary contrast media administration. Contrast media are evenly distributed in the setting of extracellular and intracellular fluids, are easily filtered and excreted by the glomerulus of a normal kidney. As contrast used in CT are iodide based contrast there use can lead to CIN and the risk increases in those patients who have GFR <30ml/min. Literature suggests that the cheapest and efficient method to avoid CIN is to avoid repeated CT examinations [23, 24].

A total of 385 patients were included in this research 162 females (42.1%) and 223 males (57.9%) (Table-1) with a mean age of 38.2±22.5-year (1-100 years) (Table-2). Table-1 clearly depicts that the male ratio of having CT scan is more as compared to females this is because most of the male patients that had CT scan had RTA, as our society is male dominant and the vehicles such as motorbikes are used by the young youth of our country and it is considered against values if a female rides a motorbike [25]. The region of interest included abdomen with a frequency of n=23(6%), Brain scans were done more frequently accounting for n=340(88.3%), Chest scans with n=14(3.6%), foot scan with a frequency of n=2(0.5%), knee scan accounting for n=1(0.3%), Lumbar spine n=1(0.3%) and neck scans with a frequency of n=4(1%) respectively. Out of all the scans performed the results included were adenexal mass, ascites, bronchiectasis, hepatic nodule, hepatic cyst, infection, intestinal obstruction and meningioma all individually accounted for n=1(0.3%), atrophy n=8(2.1%), contusion n=11(2.9%), fracture n=38(9.9%), hematoma n=33(8.6%),haemorrhage n=25(6.5%) and infarction n=51(13.2%). Out of these 147(38.2%), patients had normal CT scans with no pathological findings (Figure-1). The intravenous contrast was administered in 74 patients (19.2%) the remaining patients n=311(80.8%) had plain CT scans (Figure 2). The result of the CT exams was made considering the radiological findings in the form of scoring ranging from score 0-2. The score 0 was assigned to the patients who did not have any pathological findings and there CT scan results were normal. The score 1 was assigned to the patients who had suspicious findings. The score 2 included those patients who had a confirmed pathological finding with regards to the complaint mentioned in their CT request form. In this study 147 patients (38.2%) were categorized underscore 0 they were having no pathological finding and their results were normal, 25patients (6.5%) were categorized underscore 1 they had suspicious findings and were considered for follow up scan and the remaining 213(55.3%) patients were categorized underscore 2 they had confirmed pathology (figure-3).

CONCLUSION

According to our study, it is concluded that the rate of unnecessary CT scans performed in our country is 38.2% which is considerably high. Unnecessary CT scans can lead to the risk of developing CIN, increase healthcare cost, causes a delay in patient treatment and exposure to radiations. This unnecessary rate of CT scans can be reduced by carefully taking the patients history, checking the patient for repeat scans and considering any other non-ionizing modality such as US or MRI. By educating the physician as well as the technologist about the harmful effects of radiation, the cost of diagnostic imaging and by using properly defined imaging protocols the rate of unnecessary CT scans can be reduced.

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