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Radiation Exposure in Patients with Multiple Trauma in Level 2 and 3 Triage During first 48 Hours of Admission; a Cross-Sectional Study

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Abstract

Introduction: Recently, radiological imaging could be help to diagnose injury in the patients with multiple trauma in the emergency department (ED).

Objective: In this study, we aimed to compare the radiation exposure within 48 hours, in patients with multiple trauma in level 2 and 3 triage admitted to ED.

Method: This cross-sectional study was conducted on patients with multiple trauma of Level 2 and 3 triage who were referred during 2014-2015 to the EDs of Imam Khomeini Hospital of Tehran and Alzahra hospital of Isfahan, Iran. Radiation exposure of radiographies and computed tomography (CT) scans in patients were calculated during the first 48 hours of admission.

Results: In this study, 220 patients with the mean age of 35.41±15.04 years were studied of whom 120 patients (54.5%) were male. The mean radiation exposure was 3.43±3.12 mSv. The mean radiation exposure of CT-scan in level 2 was significantly higher than level 3 ($p<0.001$). On the other hand, the mean radiation exposure of radiography in level 3 was significantly higher than level 2 ($p=0.022$). Also, the mean radiation exposure of total radiation in level 2 was significantly higher than level 3 ($p<0.001$).

Conclusion: In 48 hours admitting to emergency department, patients with multiple trauma in Level 2 had more radiation exposure than Level 3.

Key words: Emergency Service, Hospital; Multiple Trauma; Radiation Exposure; Radiography

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INTRODUCTION

Multiple trauma is one of the most common reasons of patients' reference to the emergency department (ED). Multiple trauma is the first cause of mortality and one of the most important causes of morbidity and disability in general population (1-3). Trauma and post traumatic cares are the main factors imposing heavy economic and social burdens on the hygiene system. Most important diagnostic methods used for traumatic patients, are different imaging techniques, such as simple radiography, ultrasound, computed tomography (CT) scans and even magnetic resonance imaging (MRI) (4). Amongst various radiographic modalities, X-rays are used in simple radiography and CT scan, that may have associated with the risk of long term problems such as cancer, even at low doses (5).

On the other hand, using imaging on patients with trauma is very important, and this importance, based on the existence of the indications, worth using potentially harmful imaging techniques. According to Advanced Trauma Life Support (ATLS) recommendations, using cervical, pelvic, and chest radiographic is one of the primary interventions in the management of patient with trauma (6). But sometimes, the patient may require more modalities than suggested ones, due to the uncertainties in the trauma mechanism and the type of injury. But the higher the radiation exposure in patients, the greater the late risk. Another issue is the great importance of using such modalities in children, which its frequency is increasing and subjected to contemplation. In general, there is no accurate statistics data on the radiation exposure received by the patients in hospitals of the country (Iran), and given the expansion of facilities, it is assumed that this level is significantly higher than its standard (7). Therefore, in this study, it was tried to find out that the amount of radiation received by trauma patients in 2nd and 3rd levels of triage, during the first 48 hours of admission in ED.

METHODS

Study design

This cross-sectional study was conducted during ... until 2014-2015 in Imam Khomeini Hospital of Tehran and Alzahra Hospital of Isfahan, Iran. The protocol of this study was approved by Research Committee of Yazd University of Medical Sciences (IR.SSU.MED.REC.1393.561).

Study population

All traumatic patients aged between 18 and 80 years with consent for participating in the study referred to the ED of the mentioned hospital were included. Also, patients who died during the first 48 hours of admission or had unstable vital signs and any other restrictions in performing radiography and CT scan, were excluded. The sample size was calculated based on sample size formula ($Z_{1-\alpha}$=1.96, Z_{β}=0.84, and d=0.4sd) and it was 110 patients in each group. Patients were enrolled based on consecutive sampling method.

Data gathering

Data were collected within the first 48 hours of admission for each patient. The types of radiographies (their number) and CT scans (their number) were determined and entered in a special form for each patient. After entering patients, their information were entered into the pre-prepared checklist and each patient was followed up for 48 hours. Patients were compared based on the level of trauma in ED. Radiations induced by any radiography were determined according to previous studies and recorded in millisievert (mSv). In fact, the typical dose in a radiography was estimated based on valid references. Approximately, each radiography radiates 0.033 mSv per patient, and on the other hand, if the radiated part is the abdominal or pelvic region, each radiography has its own radiation level (9-11). Also, in each CT scan, the amount of radiation received by the dose length product (DLP) specified in the image archives was determined, and eventually the radiations received from patients were recorded. The formula for calculating DLP is as follows:

DLP = (CTDI vol) * (length of scan, cm)

Also the resulting unit is obtained in mGy * cm (12). Its unit can be converted to mSv. In this study, the amount of CT scans received on this unit were reported, it is worth noting that a chest CT scan has 5 to 10 milliard radiations, while a chest radiology image has two 0.05 mSv.

Data analysis

Data were entered into the SPSS software version 24, quantitative data were presented as mean and standard deviation and qualitative data were presented as frequencies and percentages. The normality of data was checked by Kolmogorov-Smirnov test. Chi-square test was used for comparing quantitative data between two groups, and independent t test was used for comparing qualitative data. P-value less than 0.05 was considered as the significant level.

RESULTS

In this study, 220 patients with the mean age of 35.41±15.04 years were studied of whom 120 patients (54.5%) were male. The mean radiation exposure was 3.43±3.12 mSv.

The patients divided into two groups of 110 in 2nd level (56 males and 54 females) and 3rd level (64 males and 46 females). There was no significant difference between the groups in terms of age (p=0.143) and gender (p=0.171). The mean radiation exposure of CT-scan in 2nd level was

Table 1: The variables studied based on level 2 and 3 triage

Variable		Triage		P-value
		Level 2	Level 3	
Age (year)		36.42 ± 14.70	33.45 ± 15.32	0.143
Sex	Man	56 (50.9%)	64 (58.2%)	0.171
	Female	54 (49.1%)	46 (41.8%)	
Radiation exposure of CT (mSv)		4.86 ± 4.03	1.45 ± 2.56	<0.001
Radiation exposure of radiography (mSv)		0.10 ± 0.04	0.12 ± 0.04	0.022
Total Radiation exposure (mSv)		4.96 ± 4.02	1.57 ± 2.56	<0.001

Table 2: The radiation exposure based on gender

Variable	Male	Female	P-value
Radiation exposure CT (mSv)	2.52±3.12	3.15±1.36	0.444
Radiation exposure of radiography(mSv)	0.11±0.03	0.13±0.04	0.752
Total Radiation (mSv)	3.32±3.21	3.52±2.94	0.442

Table 3: Correlation between age and radiation exposure

Age	Radiation exposure CT	Radiation exposure of radiography	Total Radiation
r	0.22	0.32	0.12
P-value	0.65	0.48	0.96

significantly higher than the 3rd level (p<0.001). On the other hand, the mean radiation exposure in radiography imaging for the 3rd level was significantly higher than the 2nd level (p=0.022). Also, the mean of total radiations in the 2nd level was significantly higher than the 3rd level (p<0.001) (Table 1). It should be noted that 79 patients (71.8%) in 2nd level and 29 patients (26.4%) in 3rd level required CT scan (p<0.001). In addition, CT scan was repeated for 4 patients in the 2nd level. It should be noted that there was no significant relationship between two genders in radiation exposure of CT scan (p=0.444), radiography (p=0.752) and total received radiations (p=0.442) (Table 2). Also, Pearson correlation showed that there is no relationship between age and radiation rate of CT scan, radiography and total radiations (p>0.05) (Table 3).

Discussion

According to the results of our study, the radiation exposure in traumatic patients, admitted to the emergency in the 2nd level, is higher than 3rd level emergency patients, due to the fact that the demand for CT scan in 2nd level of emergency is more than 3rd level of emergency. On the other hand, the radiation received from radiology or radiology required in the 3rd level of emergency is higher than the 2nd level of emergency. Therefore, due to the complications of radiology and CT scan, it is better to ask for less radiation.

A study by Sung You et al., evaluated the radiation exposure in traumatic patients in a relatively high sample size in 2010-2011. In this study, 11676 patients with an average age of 28 years were investigated who 7.8% of these patients had CT scan, each traumatic patient received an average radiograph of 2.6 mSv. Also, there was a significant difference between the amount of radiation received and the mechanism of injury, such that traumatic patients who had injury mechanism of accidents or fall received more radiation (8). In another study by Schears et al., on emergency traumatic children, it was concluded that the repetition of CT scan in these children was between 35% and 40%, and factors increasing the amount of radiation in these patients, could include repetition of CT scans, trauma without accident, and imaging outside the hospital (9). In another study that evaluated the amount of radiation in traumatic patients in the first level of emergency, it was concluded that out of 1,124 patients of total number of 3900 patients requested, 25.4% had a positive graph. CT scan was also required for 813 patients or 72.1% of cases (1890 times). On the other hand, with positive findings in 43.4% of cases, normal radiological findings were significantly higher in those with unstable hemodynamics than patients with normal hemodynamics. On the other hand, the mean radiation in all patients was 8.46±7.7 mSv and patients with poly-trauma had a radiation dose of 14.3±9.5 mSv (10). In a study, it was found that traumatic patients received a radiation dose of 22.7 mSv, which the thyroid had the highest received dose of this radiation (58.5 milliseconds) (11). In a study by James et al., it was found that the mean dose of radiation in traumatic patients, at the first 24 hours, was 40.2 mSv (12). In another study, the dose received by lungs was 42 to 91 milliseconds and the dose received by women's trachea was 50 to 80 milliseconds (13). Another study has shown that even the new technique (ldox) in imaging does not significantly change the dose of exposure in patients and only increases the speed of surgery (14). Brenner et al. argued that the abundance of CT scan in children is also rising as in adults. It was found that the risk of malignant cancers has significantly been increased by increasing doses in CT scans for humans (15). In a study by Burner et al., it was stated that there is a linear relationship between the risk of cancer and low-dose radiation, but this issue requires more research and cohort studies (16).

Limitations

The main limitation of the current study is that radiation exposure was estimated based on the probability level. We were not able to measure the exact amount of radiation exposure per patient. Certainly different radiology and CT scan devices based on friction rate and other factors may not transfer standard radiation to the patient. Therefore, it is better to measure the actual amount of radiation in such studies using a dosimeter device.

Conclusions

Based on the results of this study and other studies on traumatic patients admitted to the emergency room, they usually receive large amounts of radiation, which is due to the over-diagnosis, and on the other hand, if patients are properly and accurately examined, the amount of radiation in their radiology will be less. So according to the results of this study, it seems that in the first 48 hours of admission, patients with 2nd level of trauma receive more radiation than those in the 3rd level.

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AUTHORS' CONTRIBUTION
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CONFLICT OF INTEREST
None declared.

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REFERENCES
1. Borgman M, Spinella P, Holcomb J, Blackbourne L, Wade C, Lefering R, et al. The effect of FFP: RBC ratio on morbidity and mortality in trauma patients based on transfusion prediction score. Vox Sang. 2011; 101(1): 44-54.
2. ITLS. International Trauma Life Support for Emergency Care Providers, Global Edition: Pearson Education Limited; 2017.
3. Jones CMC, Cushman JT, Lerner EB, Fisher SG, Seplaki CL, Veazie PJ, et al. Prehospital trauma triage decision-making: a model of what happens between the 9-1-1 call and the hospital. Prehosp Emerg Care. 2016;20(1):6-14.
4. Miele V, Piccolo CL, Trinci M, Galluzzo M, Ianniello S, Brunese L. Diagnostic imaging of blunt abdominal trauma in pediatric patients. Radiol Med. 2016 May;121(5):409-30.
5. Shore RE, Moseson M, Xue X, Tse Y, Harley N, Pasternack BS. Skin cancer after X-ray treatment for scalp ringworm. Radiat Res. 2002 Apr;157(4):410-8.
6. Kortbeek JB, Al Turki SA, Ali J, Antoine JA, Bouillon B, Brasel K, et al. Advanced trauma life support, the evidence for change. J Trauma. 2008 Jun;64(6):1638-50.
7. Amis Jr ES, Butler PF, Applegate KE, Birnbaum SB, Brateman LF, Hevezi JM, et al. American College of Radiology white paper on radiation dose in medicine. J Am Coll Radiol. 2007 May;4(5):272-84.
8. You JS, Lee H-J, Chung YE, Lee HS, Kim MJ, Chung SP, et al. Diagnostic radiation exposure of injury patients in the emergency department: a cross-sectional large scaled study. PloS one. 2013;8(12):e84870.
9. Schears RM, Farzal Z, Farzal Z, Fischer AC. The radiation footprint on the pediatric trauma patient. Int J Emerg Med. 2018 Mar 14;11(1):18.
10. Giannakopoulos G, Saltzherr T, Beenen L, Streekstra G, Reitsma J, Bloemers F, et al. Radiological findings and radiation exposure during trauma workup in a cohort of 1124 level 1 trauma patients. Langenbecks Arch Surg. 2017 Feb;402(1):159-165.
11. Tien HC, Tremblay LN, Rizoli SB, Gelberg J, Spencer F, Caldwell C, et al. Radiation exposure from diagnostic imaging in severely injured trauma patients. J Trauma. 2007;62(1):151-6.
12. Winslow JE, Hinshaw JW, Hughes MJ, Williams RC, Bozeman WP. Quantitative assessment of diagnostic radiation doses in adult blunt trauma patients. Ann Emerg Med. 2008;52(2):93-7.
13. Einstein AJ, Henzlova MJ, Rajagopalan S. Estimating risk of cancer associated with radiation exposure from 64-slice computed tomography coronary angiography. JAMA. 2007;298(3):317-23.
14. Boffard KD, Goosen J, Plani F, Degiannis E, Potgieter H. The use of low dosage X-ray (Lodox/Statscan) in major trauma: comparison between low dose X-ray and conventional X-ray techniques. J Trauma. 2006;60(6):1175-83.
15. Brenner DJ, Elliston CD, Hall EJ, Berdon WE. Estimated risks of radiation-induced fatal cancer from pediatric CT. AJR Am J Roentgenol. 2001;176(2):289-96.
16. Brenner DJ, Doll R, Goodhead DT, Hall EJ, Land CE, Little JB, et al. Cancer risks attributable to low doses of ionizing radiation: assessing what we really know. Proc Natl Acad Sci U S A. 2003 Nov 25;100(24):13761-6.