Editorial

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In reference to the article of Ganei and his colleagues[1] in this issue of *Arch Iran Med*, about the correlation of HRCT with cardiopulmonary exercise in mustard gas victims who had near normal spirometry results, the following points are important:

Firstly, after development of pulmonary physiology and chest radiology, numerous works have been undertaken regarding the clinico-pathologico-radiologic correlations; however, the results were inconclusive and non-linear, particularly in cases of mild lung involvement. This is perhaps due to the large reserve capacity of the lungs and good compensation for disease process with auto- regulation mechanisms.[2] Although HRCT gives more information about lung parenchyma and small airways, and we have good literature regarding HRCT and lung disease including small airway disease,[3] the major drawbacks of HRCT are radiation exposure and impact on the outcome of most patients if we consider other less damaging diagnostic modalities. The cost and availability of HRCT are other points that may be important in developing countries, which have resource limitations.

The second point concerns ethical considerations in research. As mentioned above, after the invention of CT and its other modalities, and lack of awareness or ignorance of medical societies about the radiation danger of CT scans even within permitted levels, significant investigations were undertaken with CT and its modalities in various aspects of lung diseases including small- airway diseases as it is evident in Teels review.[3] Performing repeated and clinically non-beneficial research in spite of knowing the potential danger of radiation must be ethically considered. Our mustard gas victims *per se* are more predisposed to carcinogenesis because of 1) exposure to mutagenic mustard gas, 2) active or passive smoking, 3) living in highly polluted large cities, 4) the carcinogenic effect of natural radon gas, 5) stress and depression, in addition to 6) exposure to known dietary carcinogens (e.g., contaminated rice and water). Co-carcinogenesis is also a well known process. Therefore exposing people, particularly those most susceptible such as mustard gas victims and children, to the dangers of imaging radiation, especially for repeat or clinically non-applicable radiologic studies should be cautiously considered and ethically justified. I have seen some mustard gas victims with 4 – 5 kg X-ray films and the question is what we will gain and what we will lose in the future.

Nowadays that alarming evidence regarding the lack of safety of radiologic imaging, especially for those with high radiation exposure is growing (Table 1), our health authorities should arrange rigid and well supervised controls on X-ray dependent imaging studies which are performed everywhere, even in the absence of clear and well-justified indications.[4–6] Radiologic societies must consider the ALARA principle in imaging studies and use alternative safe diagnostic modalities if possible. This principle should be conveyed to all medical students, residents, fellows, and stakeholders.[7–9] Ethical committees should be scrupulous in accepting and justifying research work that involves exposing people to radiation and should also consider the cost-benefit issue of research. As a physician we must always keep in mind Dr. Osler's words "First do no harm" in all medical activities, including diagnosis, treatment, and research.

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Table 1. Most common radiologic studies and their comparable radiation dose with natural radiation exposure (*The table has been taken from reference 7, Change the structure and adoption were done by permission from the corresponding author of the reference.*)

For this procedure:	* Your approximate effective radiation dose is:	Comparable to natural background radiation for:
ABDOMINAL REGION:		
Computed Tomography (CT)-Abdomen and Pelvis	15 mSv	5 years
Computed Tomography (CT)-Abdomen and Pelvis, repeated with and without contrast material	30 mSv	10 years
Computed Tomography (CT)-Colonography	10 mSv	3 years
Intravenous Pyelogram (IVP)	3 mSv	1 year
Radiography (X-ray)-Lower GI Tract	8 mSv	3 years
Radiography (X-ray)-Upper GI Tract	6 mSv	2 years
BONE:		
Radiography (X-ray)-Spine	1.5 mSv	6 months
Radiography (X-ray)-Extremity	0.001 mSv	3 hours
CENTRAL NERVOUS SYSTEM:		
Computed Tomography (CT)-Head	2 mSv	8 months
Computed Tomography (CT)-Head, repeated with and without contrast material	4 mSv	16 months
Computed Tomography (CT)-Spine	6 mSv	2 years
CHEST:		
Computed Tomography (CT)-Chest	7 mSv	2 years
Computed Tomography (CT)-Chest Low Dose	1.5 mSv	6 months
Radiography-Chest	0.1 mSv	10 days
DENTAL:		
Intraoral X-ray	0.005 mSv	1 day
HEART:		
Coronary Computed Tomography Angiography (CTA)	16 mSv	5 years
Cardiac CT for Calcium Scoring	3 mSv	1 year
MEN'S IMAGING:		
Bone Densitometry (DEXA)	0.001 mSv	3 hours
WOMEN'S IMAGING:		
Bone Densitometry (DEXA)	0.001 mSv	3 hours
Mammography	0.4 mSv	7 weeks

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