Iran. J. Radiat. Res., 2012; 10(3-4): 201-203

- ***Letter to editor***

Dear Prof. Mozdarani,

I would like to discuss about some important aspects regarding the article published in, *"Iran. J. Radiat. Res., 2012; 10(2): 89-94* "with title of "*Patient doses from X-ray computed tomography examinations by a single-array detector unit: Axial versus spiral mode" by* Ghavami *et al.* (1), so according to journal policy and in suitable manner please ask the authors to reply to the comments.

According to the AAPM report no. 96 (2) and also authors according to the reference number 18 in the published article (3), mentioned that Computed Tomography Dose index (CTDI) can be measured by the dose profile, D (z), for a single slice, divided by the nominal slice thickness (T) according equation (1):

$$CTDI = \frac{1}{T}\int_{-\infty}^{+\infty} D(z)dz \qquad \textbf{(1)}$$

Measurements of CTDI in air ($CTDI_{100,air}$) and in the cylindrical polymethyl methylacrylate (PMMA) phantoms ($CTDI_{100,phantom}$) for head and body is possible Combination of $CTDI_{100}$ at 1 cm below the surface ($CTDI_{100,p}$) and at the center ($CTDI_{100,c}$) of phantoms yields a weighted CTDI ($CTDI_w$) that provides an indication of the average dose over a single slice for each setting of nominal slice thickness. Where 100 denote to ion chamber length in mm. Normalized average dose to the slice is approximated by the weighted $CTDI_w$, normalized to unit

$$\text{mAs:} \quad {}_nCTDI_w = 1/C\ (1/3CTDI_{100,c} + 2/3CTDI_{100,p}) \qquad \textbf{(2)}$$

Where C is the mAs.

For spiral mode, pitch factor is added to the equation, and then the term volume CTDI ($CTDI_{vol}$) is introduced.

$$CTDI_{vol} = CTDI_w/Pitch \qquad \textbf{(3)}$$

where pitch is the ratio between table increment per rotation and beam width. CTDI values are expressed in mGy. CTDI values should be measured for different sets of mAs, kVp, slice thickness,…to verify different aspects of it. The Dose Length Product (DLP) for a complete examination:

DLP = $\sum_i nCTDI_W.T.N.C$ **(4)** (in mGy.cm) for Axial scan and DLP=$\sum_i {}_nCTDI_{vol}.L.C$ **(5)** for spiral scan.

where i represents each scan sequence forming part of an examination and N is the number of slices, each of thickness T (cm), L is the scan length in cm for spiral scan and radiographic exposure C (mAs).

Therefore, based on the above mentioned basic concepts, the following comments need to be verified by the authors:

1. Authors haven't mentioned the procedures for measuring $CTDI_w$ and $CTDI_{vol}$ for different parameters sets and they have just mentioned to 2 values of 13 and 5.5 mGy for head and body, respectively and with the following parameters: 120 kVp, 100 mA, 2

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seconds, and 10 mm slice thickness, which the $CTDI_w$ for this parameter sets is about two times more than mentioned values except if those values be related to 100mAs.

2. Authors generally said a pitch value of 1.2 and 1.3 has been used for all spiral scans, so $CTDI_{vol}$ (Spiral) should be less than $CTDI_w$ (Axial) according to above mentioned equation (3), while authors in abstract said all axial CTDI are higher than spiral CTDI (in the result section it is vice versa!), how they derived, measured or calculated these values? Although in Table 2 for Abdomen and Pelvis axial CTDI are higher than spiral, especially, in abdomen case CTDI value is abnormally too much higher (about 3.5 times) than spiral mode, Why?
3. It was much better to show exposure parameters (mAs. kVp, No. of slices, slice thickness (beam collimation) and pitch) for each examination to be able to judge the results efficiently. Also the values in parentheses are not defined in Table 2, what are those?
4. Authors according to equation 3 of above mentioned article has measured DLP, how authors can define the scan length (L)? As DLP means CTDI*L (equation (3)). Please refer to item 8.
5. In Table 1, the mean values for number of slices and their thickness are shown, while it is not usual to display these values without mentioning to CT examination area. You can't compare axial and spiral scans without mentioning to anatomical area, this table means for a defined anatomical area in axial mode, scan length = N*T=24*4.7=112.8mm while in spiral, it is equal to 46*7.7=354 mm (more than 3 times for spiral mode! Could you please say which part of body can be scanned more than 300% in spiral mode compare to axial mode?
6. It was much better to show range of No. of slices and slices thickness (min & max) while the mean values for thickness in decimal order is unusual. Also other scan parameters should be showed in a table.
7. Authors has resulted that CTDI are higher for axial mode because of different slices thickness 4.7 and 7.7 for axial and spiral, respectively. It has to be mentioned, CTDI is a normalized value to slice thickness (Beam Collimation) as it is obvious from above formula (equation (1)). So, if beam collimation be correct, the CTDI for different slice thickness simply is the same! But for some Single Detector CT (SDCT) scanners, (not all of them, you have to measured CTDI for different beam collimation), there is some over beam collimation, generally for slice thickness 1-2 mm. And actually, the difference between axial (conventional) and spiral scans in terms of CTDI is pitch factor nothing else if other exposure parameters (mAs and kVp) be the same (equation (3)). Also for evaluating the accuracy of beam collimation or dose sensitivity profile, simply you can use film, however CTDI measurements can help in this situation as also in reference [3] has been showed for thickness 1 mm, CTDI is higher than other thickness while for thickness 2 mm it is abnormally much lower than the others and for other thickness (3,5,7,10mm) the CTDI in air and phantoms and for both mode(axial and spiral) are almost the same for their scanner [3].
8. As it has been mentioned in item 3) it was much better to show exam parameters for Table 2, but according to this table and equation (4,5), scan length= DLP/CTDI so by dividing column 4 to column 3 and also column 4 to column 3 from table 2 you have to derived scan length as below table for axial and spiral scan respectively:

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Region	Axial Average $CTDI_w$ (mGy)	Axial DLP (mGy.cm)	Axial Scan Length	Spiral Average CTDI (mGy)	Spiral DLP (mGy.cm)	Spiral Scan Length(cm)	Length Considering Pitch = 1.3 (cm)	Length Considering Pitch = 1.2 (cm)
Head	49.4	730	14.8	54	1345	24.9	19.2	20.8
Neck	7.1	85	12.0	18.3	765	41.8	32.2	34.8
Chest	4.7	13.7	2.9	6.2	290	46.8	36.0	39.0
Abdomen	39.3	375.4	9.6	11.3	569.7	50.4	38.8	42.0
Pelvis	11.9	236	19.8	9	472.5	52.5	40.4	43.8

Considering pitch factors 1.3, 1.2, scan length will be decreased by those values and is shown in last two columns of above table. In axial mode, apparently DLP for chest should be 137 instead of 13.7 mGy.cm so scan length 29 cm is acceptable. So in axial mode, except for abdomen scan all scan length are logic and acceptable.

But in spiral mode, there is unbelievable scan length even if you considering pitch factors for those regions. (Refer to item 4)

It is obvious that the methods for calculating DLP or measuring CTDI and so effective dose in spiral mode is need to be verified more accurately in this article considering CT exam parameters.

REFERENCES

1. Ghavami SM, Mesbahi A, Pesianian I (2012) Patient doses from X-ray computed tomography examinations by a single-array detector unit: Axial versus spiral mode. *Iran J Radiat Res, 10: 89-94.*
2. AAPM report no. 96, The measurement, Reporting, and Management of Radiation Dose in CT, *Report of AAPM Task group 23.*
3. Imhof H, Schibany N, Ba-Ssalamah A, Hojreh A, Kainberger F, krestan C, Kudler H, Nobauer I, Oh YR (2003) Spiral CT and radiation dose. *European Journal of Radiology, 47: 29-37.*

N.B.

This letter is forwarded to the corresponding author of the article, Dr. A. Mesbahi immediately after receipt. However Dr Mesbahi without any reply to the raised comments by Dr. Khosravi accepted the letter to be published without his reply.

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