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Preliminary Study of Image Quality in MSCT Through Qualitative Parameters for Adult Abdomen Routine in Rio de Janeiro, Brazil

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1. Introduction

Computed tomography image acquired is the end product of a series of processes from the generation of x rays to the reconstruction algorithms it. So, be influenced by the choice of protocol implemented as well as the particular requirements of the radiologist [1] and the inherent characteristics of the patient and the scanner.

Several methods, both quantitative and qualitative, have been designed to evaluate the image quality, in order to ensure its diagnostic quality. However, in many cases the quantitative assessment is beyond the scope of the medical center.

2. Methods

Two different scanners at two hospitals, one private (Brilliance 40, Philips) and one public (MX4000, Philips) were evaluated in terms of image quality and dose index associated to each patient study. The $_{n}C_{w}$was determined to access the average mAs used in each patient study.

In each institution the ACR CT accreditation phantom [3] was used to assess the image quality of the adult abdomen protocol and the software ImageJ [2] was used to evaluate the images, different macros were developed to evaluate each of the parameters of the modules of the phantom to ensure repeatability and eliminate a qualitative evaluation.

Samples of 76 adult abdomen routines in patients were assessed by compiling data from the technical parameters and inherent parameters of each patient (gender, age, height and weight). Clinical images were evaluated quantitative in terms noise and contrast noise ratio (CNR) in lesions identified by expert radiologists and noise. The methodology followed for noise measurements in patient scans is described in the reference [1]. In addition, ROIs were drawn on the lesions and surrounding tissue for the CNR determination.

The geometrical dimensions of the patients were determined in the slices in which noise measurements were performed, recording lateral and PA dimensions in the first and last slice analyzed, determining its average value, and then calculating the effective diameter. In all cases WW and WL were adjusted, in order to clearly delineate the surface of the patient.

3. Results

Table 1. Demographic data of patient sample (mean values)

	Private Hospital		Public Hospital	
	F	M	F	M
Age (years)	53,41	63,63	49,20	55,75
Height (m)	1,63	1,69	1,60	1,71
Weight (kg)	69,33	76,79	69,86	70,75
BMI ($kg \cdot m^{-2}$)	26,03	27,01	27,25	24,10
Effective diameter (cm)	28,61	31,84	29,38	29,44

Table 2. Technical factors and dose data (mean values)

	Private Hospital	**Public Hospital**
kVp	120	120
mAs	235.8	110.9
z-axis collimation (mm)	1.25	5
No. of data channels used	32	2
Pitch	1,16	1,26
Reconstructed scan width (mm)	2,0	6,9
Reconstructed scan internal (mm)	1,00	3,39
C_{vol} (mGy)	13.3	6.3
P_{kl} (mGy·cm)	651,0	239,8

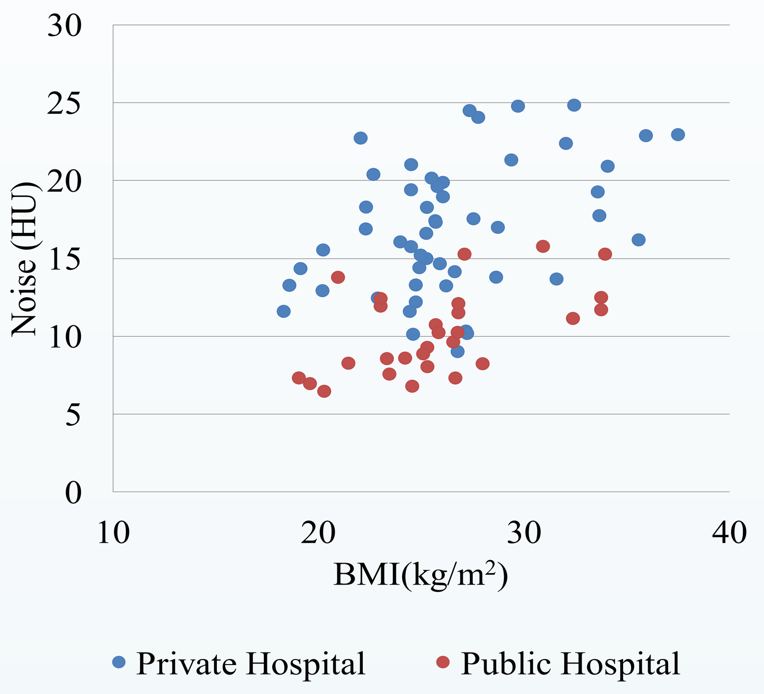

Figure 1. Variation of image noise with respect to body mass index of patients examined

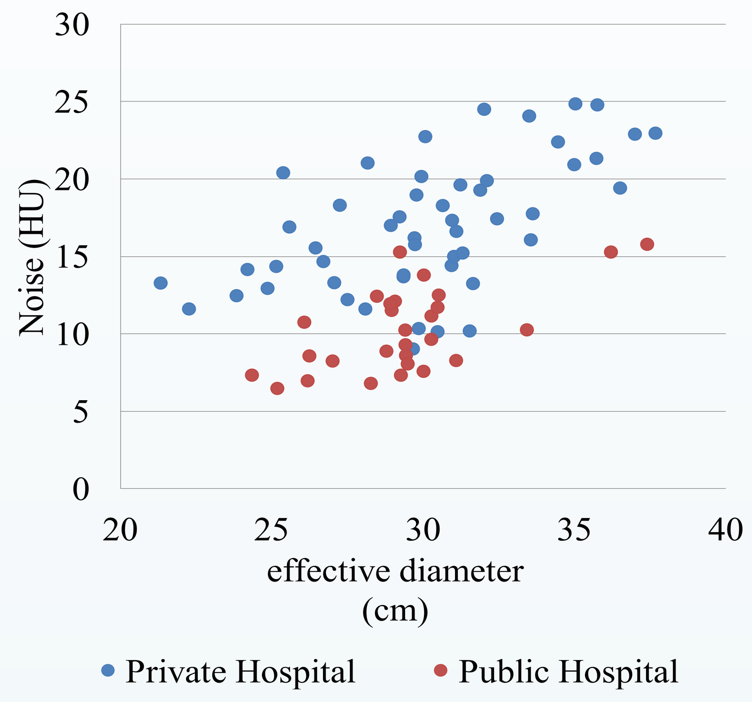

Figure 2. Variation of image noise with respect to the effective diameter of the patient examined

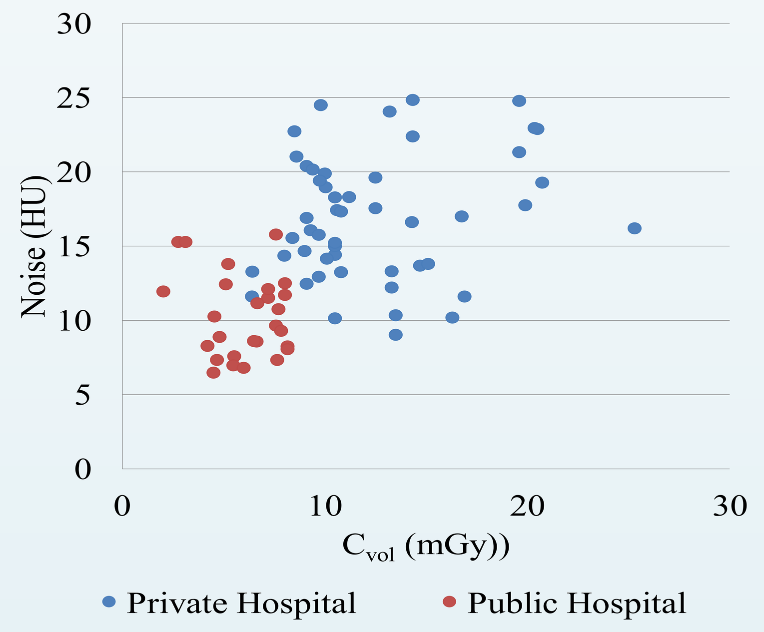

Figure 3. Comparison between noise and Cvol in medical centers evaluated

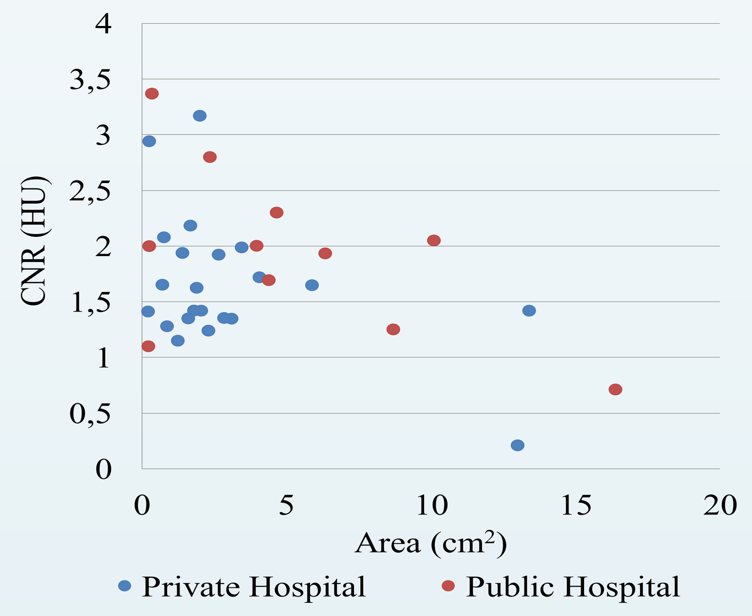

Figure 4. Lesion detection by means of CNR versus area of the lesion.

4. Discussion and Conclusions

In assessing the quality of the image with the ACR phantom, only the public hospital met all the tolerances of the ACR (in an earlier assessment, a ring artifact was observed). On the other hand, the private hospital presented problems in the CT number constancy versus kVp, in the case of 80kVp the mean value of the water cylinder was 7.23HU and the CNR ranged from 0.68 to 0.91 for 100mAs 300mAs respectively. This result is of great importance, since one of the most important factors in the study of the abdomen is low contrast resolution, given the nature of the region studied.

In the clinical images, the average noise was 14.25HU in the case of the private hospital while in the public hospital it was 9.75HU. Thus the average noise in the public hospital´s images of was 39.7% lower than private (see Figure 1 and Figure 2 for details). The $_{n}C_{w}$ estimated, for adult abdomen protocol was 0.059$mGy \cdot mAs^{-1}$ for the private hospital (-6.3% of deviation with respect to ImPACT [5]) and 0.064 $mGy \cdot mAs^{-1}$ for the public hospital. The 75th percentile in both hospitals (14.52mGy and 7.62mGy for private and public hospital respectively) was lower than the EC[4] and ACR[1] recommended value for abdomen protocol. As shown in Figure 3, by comparing the noise and C_{vol} in both institutions. It is observed how, in most cases, these two parameters are lower in the public hospital, due to the choice of technical parameters used in the medical center.

Additionally, the CNR ranged from 0.25 to 3.37HU with areas from 0.21 to 17cm^2, as shown in Figure 4. The results were similar in both hospitals, where lesions with CNR lower than the unity, were detected due to the extension of the lesion while small lesions depends on the CNR.

This study demonstrated the influence on the image quality, lesion detection and diagnostic quality by the choice of technical parameters and patient BMI.

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References

[1] IAEA. Dose Reduction in TC While Maintaining Diagnostic Confidence: A Feasibility/Demonstration Study: IAEA-Tecdoc Serie No. 1621, 2009.
[2] Wayne Rasband. 31 January 2011. ImageJ. 1.44. Retrieved March 30, 2011, http://http://rsbweb.nih.gov/ij/index.html
[3] American College of Radiology (ACR). CT Accreditation Program Requirement. 2011. Retrieved August 15, 2011, http://www.acr.org/accreditation/computed/qc_forms/Phantom_Testing_Instruction_Final.aspx
[4]European Commission (EC). European guidelines on quality criteria for computed tomography: EUR 16262. 2000. Retrieved July 11, 2011, http://www.drs.dk/guidelines/TC/quality/.
[5] ImPACT TC Patient Dosimetry Calculator 1.0.4. May 2011. ImPACT TC Patient Dosimetry Calculator. Version 1.04. Retrived from http://www.impactscan.org/ctdosimetry.htm.