ORIGINAL RESEARCH PAPER

Radiology

LOW RADIATION AND CONTRAST MEDIUM DOSE IN 64-SLICES MULTIDETECTOR CT ANGIOGRAPHY OF THORACIC AORTA

KEY WORDS: Angiographic CT, ASIR, CT, Low contrast dose, Multidetector CT (64), Radiation dose, Thoracic Aorta.

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ABSTRACT

The evaluation of chronic aortic diseases, many protocols of low radiation dose and low medium iodined contrast dose are performed.
The main aim of this study is to give a preliminary evaluation of dose reduction and iodined dose reduction. In our Hospital from February 2013 to November 2016 we selected 150 patients divided into two groups: 60 for our study and group of control of 90 cases.
All CT examinations were performed with a 64-MDCT scan. (Optima-CT GE Healtcare) Tube voltage was reduced in our study (80 kVp versus 120 in our standard) with automated current modulation system in both groups.
Concerning the iodined dose reduction, in the study groups it is strongly reduced (40 cc of 370 mg/ml versus 90 cc of 370 mg/ml): a mechanical power injector was used to administer contrast material via catheters (20-gauge) placed in antecubital vein at a flow rate of 4.5 ml/sec
Two radiologists qualitaively graded image quality of all cases defining the walls and enhancement of the lumen of the aorta. On the basis of criteria reported in the literature a five point subjective scale was used to grade image quality, from excellent (1) to non diagnostic quality(5). The reasons for degraded image quality were due to high BMI and consisted expecially in low signal/noise ratio and in two cases it was due to suboptimal contrast enhancement owing to poor bolus timing.
In the cases of low signal/noise ratio a smooth filter was applied to reduce the noise
The results of this study provide useful information about reduction of radation dose and medium iodined constrast.
Diagnostic quality of scan performed with low dose of iodine and radiation are overlays with the scans performed with standard protocol.
The study groups revealed a strong reduction dose in terms of DLP and quality of images was similar to the group of control.

1. INTRODUCTION

The reduction of the dose of contrast medium is a prominent topic in the Literature.
In fact the contrast medium is related to many problems, expecially in old patients, in particular kidney overload.
The radiation dose exposure is correlated to many neoplasms.
For these reasons in many center, the study of a low dose protocol is a bet.

2. MATERIAL AND METHODS

For this retrospective study, from February 2013 and November 2016 we selected 150 Patients referring for clinical or Doppler suspected of aortic chronic disese (age range from, 40 to 87 years), divided in o two groups: 90 Patients were the control group while 60 Patients were in the study group. These Patients were retrospective selected because in their report the volume of contrast medium was clearly defined.

All CT examinations were performed using a 64- MDCT scan (Optima CT GEHealthcare).

The technical parameters are reported in the table 1 and2

In the control group every Patient riceived a full radiation dose with 120 Kv and and automated current modulation system, while in the study group the radiation dose exposition was reduced with 80 Kv and automated current modulation system. In fact according to Marin et al (9) ASIR algorithm has the potential to reduce the exposition dose in the vascular evaluation.

In each patient, the bolus tracking tecnique (SMARTPREP; GE) was used, monitoring with a low-dose automatic timing device to optimize the delay time from the start of injection to the start of scanning at the level of the ascending aorta. . For this reason we placed a a region of interest (ROI) of average (range, 1-1.4 cm2) in the ascending aorta.

The type of contrast medium was the same in both groups, but the dose is really different, because in the control group it is 90 ml of 370 mg/ ml with a flow rate of 3,0 ml/sec, followed by 50 ml of saline flush at the same rate, while in the study group the volume is stringly reduced, and it consists in 40 ml of the same contrast, followed by 30 ml of saline flush, at higher flow (4,5 ml/sec): due to their different density, the two liquid do not mix.

In ecah group of Patients a mechanical power injector was used to administer contrast material via catheters (18- gauge) placed in antecubital vein.

Subsequent reconstructed axial images of 2 mm slice thickness were obtained using a medium-sharp convolution kernel (B20 f) with an image matrix of 512×512 pixels. We used a MDCT-A window setting (width, 400 HU; level, 100 HU).

Two high experienced radiologists, with 10 years of experience and with 5 years of experience, graded image quality of all cases , defining the walls and the enhancement of the lumen of aorta.

On the basis of criteria reported in the literature a five points subjective scale was used to grade image qulity , from Excellent (1) to non diagnostic quality (5).

The reasons for degraded image quality were due to high BMI and consisted expecially in low signal/ noise ratio and in two cases it was due to subotimal contrast enhancement owing to poor bolus timing.

In the cases of low signal /noise ratio a smooth filter was appilied to reduce the noise.

3. RESULTS

Concerning the quantitative analysis a ROI (region of interest) was placed at the origin of the ascending thoracic aorta (Point 1) and immediately above the emergency of the celiac trunk (Point 2).

We proved that there is no significant differences in density (misured in HU) between medium concentration in both aortic districts examined. In particular, if the main value was different for each patient, in both palceas, with a range between described in the table III. So we could assume that there is an optimal opacification of thoracic aorta after small contrast volume adinistration, the same of the group of control.

Concerning the noise/ ratio signal we fixed the noise index at 21.4 so the quality ot all images, qualitatively evaluated from two experienced radiologist (10 years and 5 years experienced) were unanimously considered good.

4. DISCUSSION:

The expression low dose CT is not well defined.

Many authors referred for radiation dose reduction and contrast medium reduction. According to Kyongtae, contrast enhancement is affected by numerous interestig factors, depending by patients, cotrast medium and CT-scans with thier parameters (7)

The parameters that affect the CT radiation dose include tube current and voltage, scanning modes and scanning length. Concerning the radiation exposure new authyomatic techniques have a common purpose consisting in adjusting the X-ray tube curent to compensate for different level of attenuation of the scanner's X-Ray beam. These different techiniques may be combined with Kvp modulation. Good quality of images may be obtained if the noise index is previously fixed, and in our study it is usually 21,4.

Nakayama et al, using a 16-CT row, demonstrated that, changing the tube voltage from 120 to 90 KVp, the radiation dose was reduced more then 20 % (8); the experience of Yanguangshen et al. confirms that the major advantage of lowering the tube voltage is to reduce the radiation dose. With the dual source CT they confirm the dose reduction using low voltage but with significants improvements image quality.

In our experience the radiation dose was reduced by use of ASIR; as defined by Marin D. Et al. (1) the ASIR alghoritm yields significantly improve image qulity at low- tube voltage (80 Kvp), high tube-current CT and may be an effective strategy for reducing do radiation exposure.

Ippolito D et al (2), using a 256- row CT, significantly decreased the radiation exposure by ECG- gated Aortic- CT.

Concerning the contrast reduction, a significant contribute came from Ippolito D et al (2) who, using 256 row CT, administred only 30 ml of contrast medium.

Seehofnerova A at al (3) could reduce radiation dose using dual source scanner, while the medium contrast reduction is not more significant then ours, in fact they used the technique of bolus test (10 cc) followed by the main bolus (50 cc), so in total 60 cc of contrast were administred.

E. Cakmackci et al (4) used a 128-section multidetector CT, administering 40 ml of 320 mgI/ml iodined contrast.

In our experience we used a 64-r ow CT and we gave 45 ml of contrast medium to the Patients.

Our analysis was both quantitative and qualitative.

Our results are in agree with Mourits MM et al. (10) ; in facts they highlight that low tube voltage CTA using 50 of ml CM is not inferior to CTA qt 120 kV using 100 ml. CM. Concerning the quantitative analysis, if Yamamuro et al (5), using a 64-slices multidetector CT, assumed that an optimal CT density in the coronary arteries had to be considered to be more than 250 to 350 HU, in our study we did not select an otpimal density in the aorta, because we considered that it was no necessary due to the great dimension of the vessel: our parameter concerned the variation of density through the vessel.

In particular we considered the quality of the exam correlated with a homogeneus density between the aortic root and the discending aorta, or non significant inhomogeneus density consisting in a difference of density between the two regions of maximum 50 HU.

Concerning the qualitative analysis, according to the literature (6), a five point subjective scale was used to grade image quality, where 1 was excellent, 2 was good, 3 moderate, 4 poor and 5 non diagnostic quality.

Several limits of this study sholud be mentionated: the first one concerns the Patient's size: obese Patients reqired higher kV because the signal/noise ratio was too low, as already defined by E Cakmackci et al (7) Our experience was in line with Marin et al (1) who referring to abdominal aorta, demonstrated that ASIR algorithm yields significantly lower noise and improved image quality for low-tube-voltage and high tube–current.

TAB1: Technical parameters of study group

Technical parameters:	
Velocity	110 m/sec
Pitch	1.38 mm/ rot
Rotation time	0.5 msec
Acquisition time	4,22 sec
Kv	80
Threshold	45 HU

TAB 2: Technical parameters of control group

Technical parameters:	
Velocity	91.66 m/sec
Pitch	1.38 mm/ rot
Rotation time	0.6 msec
Acquisition time	6.16 sec
Kv	120
Threshold	100 HU

TAB 3 Density Value:

		Control Group	Study Group
Minimim Density	Point 1	290 HU	196 HU
Maximum Density	Point 2	545	630 HU

Figure 1: Control Group

Figure 2: Study Group

Figure 3: Control Group. Point 1

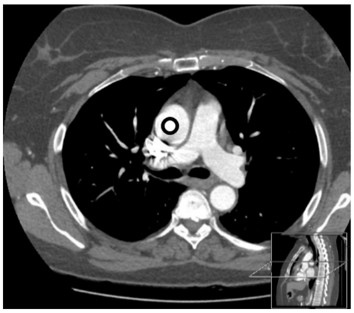


Figure 4: Study Group. Point 1

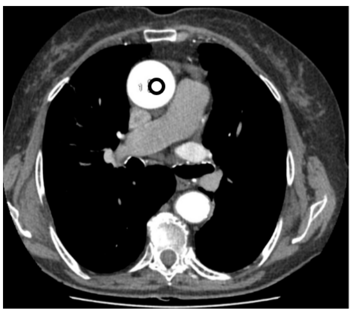


Figure 5: Control Group. Point 2.

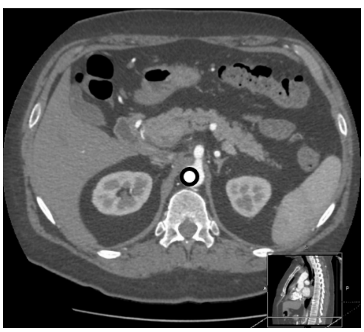
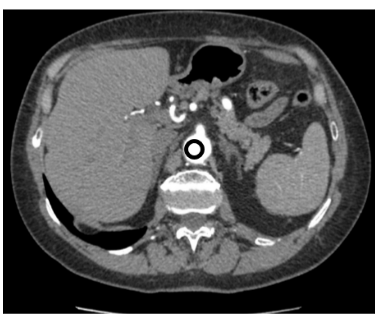


Figure 6. Study Group: Point 2.



5. CONCLUSION

The thoracic aorta may be evaluated with low amount of iodined contrast because tit allows an adeguate opacification: concerning the low radiation dose, using GE multidetector CT, with the protocol of ASIR, a good quality of images may be obtined if a high signal- noise raitio is previously fixed.

6. REFERENCES

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