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Comparison of Contrast Enhancement between Low Osmolar and Iso Osmolar Contrast Media in Pulmonary and Abdominal Aorta

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Introduction/background: In CT, iodinated contrast media is used to enhance the visibility of internal structures and vessels during radiographic imaging.Non-ionic contrast medias are hyperosmolar to blood and they are only suitable for normal creatinine level patients and it is contraindicated in high creatinin level patients. Hence a new iodinated non-ionic contrast agent iodixanol was introduced which is iso-osmolar to blood and suitable for both patients high creatinin level and normal creatinine level.

Methodology:200 participants who were referred for CECT Abdomen and pelvis were scanned using 128 slice Brilliance CT. Data was collected only from the participants referred by the physician for CECT abdomen and Thorax. After acquiring all three phases of the scan, attenuation was measured in Porto venous phase.HU was measured by placing a 1cm² circular region of interest (ROI) in the selected anatomical site. Data was analysed using SPSS software version 16.0. Statistical Analysis was done using Independent t-test with level of significance set at 5%.

Results: Average HU values were found by placing ROI on abdominal aorta and pulmonary artery for scans done using low osmolar and isoosmolar CM and their differences were correlated. Statistically significant difference was found in HU between low osmolar and iso-osmolar CM in abdominal aorta. In pulmonary artery both CM gave similar enhancement.

Conclusion: Iso-osmolar CM provide better contrast enhancement in abdominal aorta compared to low-osmolar CM.

I. INTRODUCTION

Computed tomography (CT) makes use of computed processed combination of several x-rays shot from different angles to produce cross sectional images of an object. CT demonstrates a high contrast resolution between tissues when compared to normal x-ray radiograph.**Hounsfield unit (HU**) is a quantity commonly used in CT to express CT numbers in a standardized and convenient manner, established by Sir Godfrey Hounsfield.**Contrast media(CM)**is used to enhance the visibility of internal structures and vessels during radiographic imaging.Water soluble Iodinated contrast media are of two types, ionic and non-ionic. Ionic contrast agent. Both ionic and non-ionic contrast agents are contraindicated in high creatinine level patients as they are hyperosmolar to blood. Hence a new iodinated non-ionic contrast agent iodixanol was introduced which is iso-osmolar to blood and suitable for both high creatinine and normal creatinine level patients.

The vessel and tissue enhancement after the administration of contrast agent is influenced by the iodine dose and delivery rate of contrast agent.Iodine concentration in contrast varies with different contrast media.Contrast enhancement can also vary from patient to patient. This difference is due to the individual factors like body mass index (BMI), cardiac output time.Increasing the contrast agent administration rate (flow rate) is useful to increase the iodine delivery rate. But, increase in the administration time would results in the longbolus time length and increase the possibility of scan to run out of time, particularly withthe new CT scanners, 64 and 124-slice CT scanners, which have high speed gantryrotation time and short acquisition time. On the other side increasing the contrast mediaadministration rate will also increase the risk of contrast extravasation and increasing theinjection rate is not possible always especially with old and weak patient with small orfragile arteries. Administration of contrast media which is having high iodine concentration will help to increase the iodine delivery rate there by the vessel and tissue enhancement.

The goal of our retrospective study was to correlate the contrast enhancement in abdominal aorta and pulmonary artery between low-osmolar (iohexol 300 mg I/ml) and iso-osmolar (iodixanal 320 mg I/ml) by measuring the HU in selected anatomical site.

II. MATERIALS AND METHODS

The study was retrospective cross-sectional study, conducted in 64 slice brilliance

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MDCT Philips,Department of Radio diagnosis and imaging, Kasturba Hospital, Manipal. Sample size of the study was 200 and determined by using the formula to study the correlation.Institutional Research Committee SOAHS and ethical committee of Kasturba Hospital approval were taken. Inclusion criteria of study was, Patients who were referred for the CM enhanced study for abdomen and thorax and exclusion criteria was, Patients who were allergic to CM and Non co-operative patients. Screening of subjects were done before the study started,to include in the study.

Suitable contrast agent was injected accordingly. As per the typeof contrast media received patients were classified in to two, group' A' and group 'B'.Group 'A' received low-osmolar contrast agent and group 'B' received iso-osmolarcontrast agent. After the acquisition of non-contrast phase, arterial phase and Portovenous phase attenuation were measured in Porto venous phase in two anatomical sites,abdominal aorta and pulmonary artery.

HU was measured in 2D axial plane. A circular region of interest (ROI) of 1cm², kept on two selected anatomical site. First selected anatomical site was abdominal aorta.After identifying the abdominal aorta an ROI of 1 cm² was kept on the abdominalbifurcation, then average HU was noted. Second selected anatomical site was PulmonaryArtery, where by using the same method an ROI of 1 cm² was kept on the pulmonarytrunk and average HU was noted. Collected data was represented in tabulated form.

The data was statistically analyzed using independent samples test utilizing SPSS, version 16.0 for windows

III. RESULTS

The intravascular enhancement in each anatomical site with iso-osmolar and low-osmolarcontrast agents were measured. Mean and standard deviation for low-osmolarand iso-osmolar was calculated separately for abdominal aorta and pulmonary artery(Table 1)

Table 1
Mean and Standard deviation for low-osmolar as well as iso-osmolar contrast agent inabdominal aorta and pulmonary artery

Site	Contrast media		N	Mean	Std. Deviation
Abdominal aorta	HU value	Low-osmolar	50	118.786600	23.9317480
		Iso-osmolar	50	137.725800	20.9054991
Pulmonary artery	HU value	Low-osmolar	50	127.568000	21.6458987
		Iso-osmolar	50	132.982400	18.2778684

Abdominal aorta

In abdominal aorta for a total of 50 number of subjects (N), received iso-osmolarcontrast media, calculated mean and standard deviation (Std. Deviation) was 118.786and 23.931, respectively (118.786±23.931). At the same anatomical site mean andstandard deviation for a total of 50 number of subjects, received iso-osmolar contrastmedia was 137.725 and 20.645, respectively (137.725±20.645). To select the test,distribution of variables (HU values) were analyzed using normality test. Test produced anormal distribution of variables.

Pulmonary artery

In pulmonary artery for a total of 50 number of subjects, received low-osmolarcontrast media, calculated mean and standard deviation was 127.568 and 21.645,respectively (127.568±21.645). At the same anatomical site mean and standard deviationfor a total of 50 number of subjects, received iso-osmolar contrast media was 132.982and 18.277, respectively (132.982±18.277). To select the test, distribution of variables(HU values) were analyzed using normality test. Test produced a normal distribution ofvariables.

To compare contrast enhancement between low-osmolar and iso-osmolar contrast agent an independent samples test was conducted. Significant difference in contrastenhancement was seen between low-osmolar (M=118786, SD=23.931) and iso-osmolar(M=137.725, SD=20.645) conditions; t (98) = -4.214, p = 0.00 (Table 2). Statisticallysignificant value for p was less than 0.05. These result suggest that in abdominal aortaiso-osmolar contrast media gives better contrast enhancement when compared to lowosmolarcontrast media.

Contrast enhancement between low-osmolar and iso-osmolar was compared using

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independent samples test. Significant difference in contrast enhancement was seenbetween low-osmolar (M=127.568, SD=21.645) and iso-osmolar (M=132.982,SD=18.277) conditions; t (98) = -1.351, P=0.180 (Table 2). In pulmonary artery P valueis greater than 0.05. These result suggest that in pulmonary artery low-osmolar and isoosmolar gives a similar contrast enhancement

Table 2
Independent samples t test for low-osmolar and iso-osmolar contrast agent abdominal aorta and pulmonary artery

Site			T	df	Sig. (2-tailed)
Abdominal aorta	HU values	Equal variances assumed	-4.214	98	0.00
		Equal variances not Assumed	-4.212	96.262	0.00
Pulmonary artery	HU values	Equal variances Assumed	-1.351	98	0.181
		Equal variances not Assumed	-1.351	95.325	0.181

IV. DISCUSSION

The study has shown a statistically significant difference in contrast enhancement in abdominal aorta with the administration of iso-osmolar contrast agent than lowosmolarcontrast agent and in pulmonary artery even though slight difference in contrastenhancement was shown but not statistically significant.

In literature, many studies have been conducted by using different contrast agents with different iodine concentration and flow rate to compare vessel enhancement, F. FBehrendt et.al,(1) conducted a study to compare low-osmolar monomeric contrastenhancement with and iso-osmolardimeric contrast agent in animal model. The result oftheir study was contradictory to our result. This may be due to the difference in subjectselection. They conducted the study in an animal model and our study was on humanpopulation.

Oswald Gray et.al,(2) compared iodixanol 320 mg I/ml and 300 mg I/ml, an isoosmolarcontrast agent with iopromide 300 mg I/ml. This study gave a similar result toour result. Result showed significantly better contrast enhancement with iodixanol in allmeasured anatomical sites (aorta and portal vein) but in our study only abdominal aortashowed significantly high contrast enhancement. This variation might be due to differentphysiological properties of pulmonary artery and portal vein.

Eun Young Kim et.al, (7) had done a study to compare contrast enhancement inpulmonary vessels using iodixanol 320 mg I/ml and iomeprol 400 mg I/ml. Even thoughthis study supported our study by providing a similar result but in this study, the usediso-osmolar contrast agent had less concentration of iodine than low-osmolar contrastagent. In our study high iodine concentration was there in iso-osmolar contrast agentcorrelated to low-osmolar contrast agent. The similarity in result might be due to the difference in flow rate of contrast agent. Flow rate kept for iso-osmolar contrast agentwas 6.2 ml/s and 5 ml/s for low-osmolar contrast media. This might had lead to theincreased iodine delivery rate of iso-osmolar contrast agent than low-osmolar contrastagent.

Similar to study discussed above, Lorenzo Faggioni et.al, (8) also conducted astudy to compare contrast enhancement in vessels and similar result was found.Compared to iomeprol the iodine concentration is less in iodixanol. This might behappened because they kept a constant iodine delivery rate for both contrast media eventhough the flow rate was different and in this study they included only lean patients.

Stephan Achenbach et.al, (11) and Herbert Langenberger et.al, (6) done a study to analyzethe contrast enhancement among different concentrations of iodinated contrast media. Inboth of their studies contrast media with high iodine concentrations gave better contrastenhancement. Contrast media used in their study with high iodine concentration waslow-osmolar, hence their study become a contradictory to our study. This may be due tothe different method used to calculate the

vessel enhancement. In our study we usedcomputer software to measure HU but they analyzed the image with the help of anexperienced expertise. The quality of an image depends on the person who see the image,hence it can vary but computer software gives you an exact value (HU) and it will notchange person to person who analyze the image.

V. CONCLUSION

Our study indicates that intravenous injection of iso-osmolar contrast agent canproduce better contrast enhancement in abdominal aorta correlated to low-osmolarcontrast agent. But in pulmonary both isoosmolar and low-osmolar contrast agentproduce a similar contrast enhancement.

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