学位論文内容の要旨
（Summary of dissertation）

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学 位 論 文 題 名
（Title of dissertation）

Renal volume as an additional factor to body weight for contrast dose determination in multidetector-row dynamic CT of the liver

肝造影ダイナミックＣＴの造影剤投与量決定に関し、ＣＴにより測定された腎体積は体重の補助因子である

BACKGROUND: Multidetector-row dynamic CT remains as one of the main non-invasive techniques for diagnosis of hepatic tumor, especially metastatic lesions and contrast enhancement (CE) may represent a key-factor on its diagnosis precision. Several factors were proved to affect CE, including radiological factors such as contrast medium dose and injection rate; and patient-related factors like body weight (BW) and body surface area (BSA). There is no study in the literature showing the association of renal volume (RV) with CE. **PURPOSE:** In this work, we introduce RV as an additional factor to BW on the determination of contrast material dose used in multidetector-row dynamic CT of the liver. First, we propose a semi-automated technique to accurately quantify RV and show its association with BMI, age and renal function. Second, we demonstrate the association of RV with hepatic contrast enhancement (HCE) using contrast material dose tailored by BW. Third, we assess the correlation of RV with aortic contrast enhancement (ACE) on hepatic arterial phase. This last study was deepened in the forth study using renal volume measured using unenhanced and contrast enhanced CT. **MATERIALS AND METHODS:** A phantom study was performed with 32 potatoes from 90 to 210g to estimate the accuracy of the renal volume measurement. Volumes were measured by water displacement method, then potatoes were randomly scanned in pairs in the same machine (64-section multi-detector Aquilion 64 Scanner (Toshiba Medical Systems Corporation, Otawara, Tochigi, Japan) as used in the clinical studies. From February, 2007 to March, 2010 one group of 64 patients (34 men, 30 women) from 19 to 79 years old, scanned for diagnosis or follow-up of hepatocellular carcinoma, was evaluated for studies described in chapter one, three and four, and another group of forty-five consecutive donor candidates (21 men, 24 women) for renal transplantation, from 25 to 76 years old, was assessed in chapter two. Dynamic CT scans of the abdomen were performed with protocol including hepatic arterial and late phase for the first group and arterial and late phase for the second group. For both groups, scan timing was adjusted by the bolus tracking system with and dosage of 450mgI/ kg (body weight) of iodine contrast agent; tube current via automatic exposure control; voltage, 120 kV; collimation, 64×0.5mm; reconstructed slice thickness, 5mm; and reconstruction increment, 5mm. CT slice thickness of 5mm was used and renal cortical volume (RCV) and total renal volume (TRV) were obtained. Renal medullary volume (RMV) was calculated as the difference between TRV and RCV. In the first and second studies, semi-automated method using contrast enhanced CT was used to measure TRV and RCV. In the forth study, three different modalities were used to measure the renal volumes: the ellipsoid method and the manual method using unenhanced CT; and the semi automated method using contrast enhanced CT. The time spent for renal volume measurement was tracked on manual and ellipsoid methods. Estimated glomerular filtration rate (eGFR) served as standard reference of renal function. The results were assessed by MedCalc® for Windows, version 9.3.9.0 (MedCalc Software, Mariakerke, Belgium) with paired Student *t* test, correlation coefficient and multiple regression analysis. Intra and interobserver variation and intraclass correlation coefficient (ICC) were calculated. Pearson's correlation coefficient was classified as strong ($r \geq 0.5$), moderate ($0.3 \leq r < 0.5$) or weak ($r < 0.3$). **RESULTS:** In the first chapter, the correlation between water displacement measurement and CT scan volume measurement was r=0.99, p<0.0001. TRV had average of 153 cm^3 ±39SD, RCV of 105.8 cm^3 ±28.4SD and RMV of 47.8cm^3 ±19.5SD. There was negative correlation between RCV and age. Body mass index (BMI) correlated with TRV and RCV, but had no statistically significant relationship with RMV. Renal function showed moderate correlation with RCV (r=0.57, p<0.0001). In the second chapter, HCE had average of 38HU ±7.1SD. In the multiple regression analysis, HCE was dependent only on TRV (r=-0.37, p<0.05). There was moderate correlation between HCE and TRV (r=-0.37, p=0.01). And this correlation was even stronger with RMV (r=-0.46, p=0.001). In the third chapter, the ACE obtained was 222.6HU ± 52.8SD. When correlated to ACE, TRV, RCV, and RMV had r = 0.46, (p=0.0001), r=-0.28 (p=0.0225) and r=-0.52 (p<0.001). respectively. In the fourth chapter, the ICC between ellipsoid method and manual method was 0.77, p=0.83, while that between the manual and semi-automated method was 0.9, p= 0.93 and that between semi-automated and ellipsoid method, was 0.75, p=0.86. Time spent for ellipsoid method was shorter than that spent for manual method (p < 0.013). Correlation coefficient was maximum at 0.36 (p=0.005) in the groups with smaller renal volume when a threshold at 270 cm^3 was set. In this subgroup, regression analysis formula obtained was ACE = 507.0687 - [1.1686 x TRV], where ACE is the aortic contrast enhancement in HU and TRV is the total renal volume in cm^3. **CONCLUSION:** These studies demonstrated an accurate and rapid method to measure RV using contrast CT data, in addition, showed RV as a possible factor influencing the ACE and HCE. We suggested that using BW as the only determinant on contrast material dose calculation may lead to excessive dose in those patients with small kidneys, and proposed a rapid and accurate method to measure RV using non-enhanced CT images. These results allowed adjustments on the formulas to determine contrast material dose according to the patient's individual RV in addition to BW and proposed future studies for the calculation of ideal dose of contrast material.