ID P007: Patient dose management systems: Our experience in the CT department.

Tsapaki V[1], Fitousi N[2], D. Niotis[1], Ch Triantopoulou[1], P Maniatis[1]

[1] Konstantopoulio Hospital, 142 33, Nea Ionia, Athens, Greece
[2] Qaelum NV, Gaston Geenslaan 9, B-3001 Leuven, Belgium

Abstract

Purpose : Computed Tomography (CT) scanners are equipped with a vast variety of different technology and protocols. Due to the extended range of technical parameters (kV, mA, rotation time, pitch, filters, reconstruction algorithms, etc.), radiation dose varies significantly between patients. Depending on clinical needs and patient body habitus, patient radiation dose differs, even for the same anatomical region, clinical indication, technical protocol and even for the same CT. Thus, the need to monitor, optimize and generally review medical practices in CT has risen immensely. Manually dealing with these demanding tasks can be extremely time consuming. Nowadays, sophisticated patient dose management software (PDMS) with user-friendly interface can assist to this task, resulting in an easier and quicker way to monitor and analyse data. Our study focused on getting a general overview of the software capabilities, investigating potential difficulties or practical issues during use, evaluating staff performance in the daily routine and examining if and how the PDMS could assist in a more efficient management of the department. Materials and Methods: A commercially available PDMS (DOSE by Qaelum, Leuven, Belgium) was recently installed in our CT department. The software was connected to our 64-slice CT scanner. More than 6000 CT examinations were analysed. Volumetric Computed Tomography Dose Index (CTDIvol), Dose Length Product (DLP) and Effective Dose (E) were evaluated for chest, abdomen and chest-abdomen-pelvis exams. Organ doses estimated, by the software, were also evaluated. Results: The software provided easy, quick statistical overview of clinical/technical data. Typical local doses were comparable to national/international data. Organ doses estimated proved to be a valuable tool in individualized patient dosimetry. It also provided the time periods the scanner was not in use and facilitated easy scheduling of routine quality control tests and other routine tasks. A number of errors were identified and communicated to the staff; corrective actions were taken. Conclusions: The PDMS proved to be a highly sophisticated system and a valuable tool for managing the radiology department. It provided advanced analysis that could assist for an in-depth evaluation in terms of patient dosimetry, staff performance and usage of equipment.

INTRODUCTION

The latest European Council Directive 2013/59/Euratom on basic safety standards for protection against the dangers arising from exposure to ionising radiation clearly states that medical X-ray equipment must have a means to inform the practitioner of the relevant parameters for assessing the patient dose and, even more important, to have the capacity to transfer this information to the record of the examination. Obviously, the need for an automated dose monitoring solution rises. This can be an extremely time consuming and complex task. Nowadays, sophisticated software packages with friendly interface can assist to this task, resulting in a much easier and quicker way to monitor all data included in the Digital Imaging and Communication in Medicine (DICOM) header of the CT scanner or data recorded in the Picture Archiving and Communication System (PACS) of the hospital [30-37]. Recently one such commercially available dose tracking software was recently evaluated in our hospital.

PURPOSE

The present work presents the results of this evaluation. The authors investigated if the system can be used solely for patient radiation dose analysis, or could also assist in the general management of the CT department.

METHODS

For each examination: 1) tube voltage (kV), 2) tube output (mAs), 3) Field of View (FOV), 4) pitch, 5) collimation, 6) number of slices, 7) series information, 8) scanogram and 9) operator's name were recorded. Regarding radiation dose metrics, CTDIvol and DLP are the dosimetric quantities transferred from the CT scanner to the software workstation. The software uses the patient CT exam data and calculates E and organ doses. Organ doses are estimated using conversion factors derived from Monte Carlo simulations for a standard-size model. The validation of the in-house model was already performed against commercially available dosimetric tools before the study to ensure accuracy of organ dose estimation. The study included 6,010 CT examinations. The study was performed according to the ethical standards as described by the Declaration of Helsinki. Due to the higher radiosensitivity of organs in examinations of the trunk, the authors decided to focus on these exams for further analysis. In order to estimate organ doses, the examinations were divided in 3 broad anatomical part categories: Chest, Abdomen and Chest/Abdomen/Pelvis (CAP) CT examinations.

RESULTS (1)

❖The software offered easy and quick statistical overview of all clinical and technical data of CT examinations. This overview could be provided for a specific date, for a time period within the day, or for a whole date range selected by the user.

❖Very large variability of CT protocols was noticed. Forty six (46) different scanning protocols were recorded for 16 different anatomical regions.

❖CTDIv values did not have big differences between exam protocols (Table 1).

❖DLP almost doubled from Chest to Abdomen and more than tripled from Chest to CAP exam.

❖The analysis revealed mistakes in the technique mainly related to the technical protocol (extra image series, longer scans than actually needed, wrong protocol used, or even choosing the correct protocol but typing the wrong name). All these errors were communicated to the operators and helped in the optimisation of procedures and better organisation of the department (Figure).

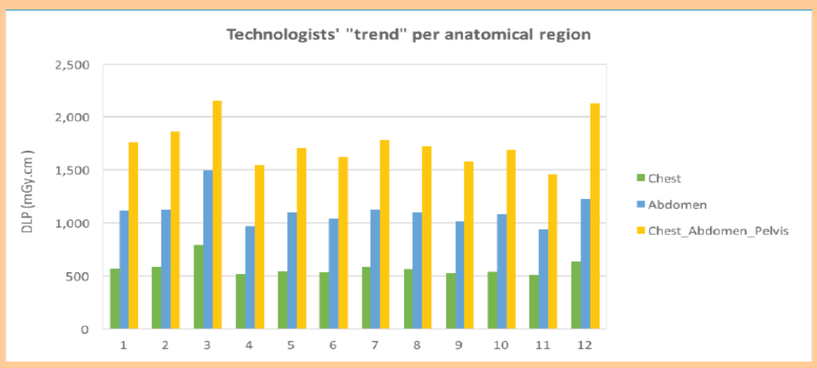
❖The large range in DLP and E values especially in CAP reflected the protocol variability. This could be partially explained by different number of series (pre-contrast, post-contrast studies, multiphase studies, etc.) depending on clinical indication and physician choice.

Table 1. Median value and range of volumetric Computed Tomography Dose Index (CTDIvol), Dose Length Product (DLP) and Effective dose (E) are shown for 3 types of CT examinations

	N ps	*CTDIvol (mGy)*	*DLP (mGy.cm)*	*E (mSv)*
Routine Chest	437	10.5 (1.4-45.2)	388.5 (51.5-1,040)	7.78 (1.0-20.8)
Routine Abdomen	410	14.8 (4.9-38.01)	706.4 (136.4-767.8)	12.0 (2.4-35.8)
Chest_Abdomen_Pelvis	566	15.3 (6.3-62.7)	1510 (290.9-5,700)	26.0 (4.9-96.9)

Table 2. Local DRLs in terms of CTDIvol and DLP are defined and presented in this table

	CTDIvol (mGy)	*DLP (mGy.cm)*
Chest	11	390
Abdomen	15	710
Chest_Abdomen_Pelvis	15	1510



CONCLUSSIONS

The dose tracking software proved to be a highly sophisticated system and a valuable tool for managing the CT department. It provided advanced analysis that could assist for an in-depth evaluation in terms of patient dosimetry, staff performance and usage of equipment.