Quality control and patient doses in computed tomography

W. Slusarczyk-Kacprzyk, W. Skrzynski, W. Bulski

Medical Physics Department
The Maria Sklodowska-Curie Memorial Cancer Center and Institute of Oncology
Warsaw, Poland

E-mail: w.bulski@zfm.coi.pl

Introduction and Purpose

- Quality control of computed tomography scanners is a legal requirement in Poland. Polish regulations also specify diagnostic reference levels for CT (adopted from European Guidelines EUR 16262).
- The aim of the work was to analyse results of quality control tests and patient doses for several computed tomography units in our centre.

Materials and Methods

- Monthly tests
  - Artefacts
  - CT numbers
  - Noise
  - Uniformity
  - Slice width
  - Couch movement
  - Positioning lights
- Yearly tests
  - Dose indices
  - Beam collimation
  - kVp
  - HVL
  - Image quality

- Doses
  - CTDI and DLP data collected for typical protocols and for groups of patients
  - Results compared with diagnostic reference levels published by the European Commission[1,2)] and by the NRPB[3)]

[1)] EUR 16262, cited in Polish law

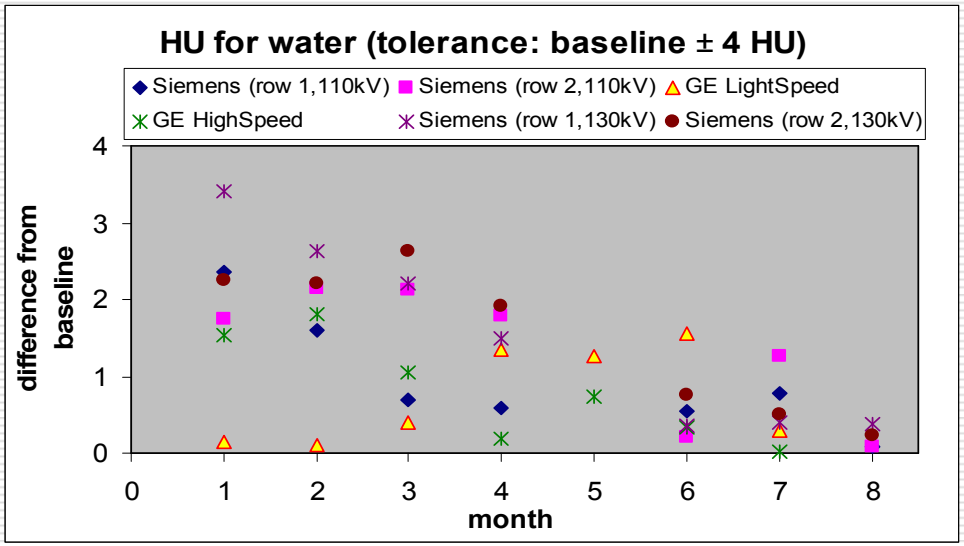
[2)] European Guidelines for Multislice Computed Tomography

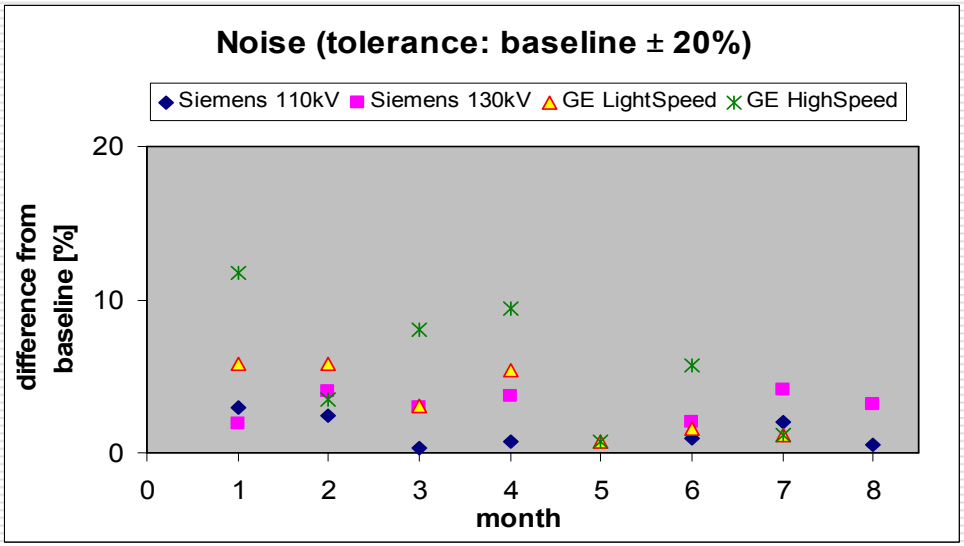
[3)] NRPB-W67

Materials and Methods

- CT scanners included in the study:
  - GE HiSpeed DX/i – single slice CT
    used for planning of radiotherapy (RT) **(left)**
  - Siemens Somatom Emotion Duo – CT on rails
    used for planning of brachytherapy (BT)
    and for intraoperational imaging **(right)**
  - GE LightSpeed Pro 32 – used for diagnostics
  - Philips Gemini TF 16 (PET-CT)

Results: QC tests





- The results of all tests were generally within limits for all examined scanners.

Results: doses

CT scanner	Examination	$CTDI_{vol}$ [mGy]					DLP [mGy x cm]				
		average	min	max	DRL EU	DRL NRPB	average	min	max	DRL EU	DRL NRPB
GE HiSpeed DX/i	Head	16.4	6.9	28.5	60	65/55	294	129	688	1025	760
	Chest	10.7	4.4	14.4	35	10/11	323	149	770	650	430
	Breast (for RT)	6.9	4.1	9.1	35	10/11	162	82	287	650	430
	Abdomen	8.8	5.9	11.0	35	13	336	204	485	780	460
	Pelvis	9.1	6.8	17.8	35	12	239	53	590	570	-
	Prostate (for RT)	9.5	7.1	9.5	35	12	157	106	176	570	-
GE LightSpeed Pro 32	Head	61.0	52.0	72.5	60	100/65	1288	777	1757	930	-
	Chest	15.0	6.9	30.9	10	13/14	653	272	1485	580	-
	Abdomen&Pelvis	24.5	9.7	43.7	15	14	1266	415.5	2058	560	-
	Abdomen	16.6	6.8	45.8	25	14	1181	339	3373	470	-
Siemens Somatom Emotion Duo	Head (for BT)	27.4	27.4	27.4	60	65/55	341	179	636	1025	760
	Breast (for BT)	8.6	5.1	10.9	35	10/11	327	173	444	650	430
	Pelvis (for BT)	6.5	4.2	10.2	35	12	121	49	333	570	-
Philips Gemini TF 16	Whole body (PET-CT)	3.5	3.5	3.5	-	-	39.4	35.6	45	-	-

Results: doses

- Patient doses for examinations of the same parts of the body differed between scanners. In some cases they exceeded the diagnostic reference levels.
- Highest doses were observed for applications that require highest image quality (diagnosis), lowest for those in which CT only provides supplementary data (PET-CT).
- CT examinations performed in our centre do not match examinations for which the levels were defined.

Conclusions

- Results of the quality control tests are satisfactory. They shall be continued as required by current Polish regulations to monitor performance of the scanners.
- The scope of examinations, for which diagnostic reference levels are published in national or international recommendations, does not match the scope of examinations performed in our centre.