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TITRE

Comparaison de la qualité d'image et de la dose en scanner thoracique pédiatrique avec et sans filtre étain : étude rétrospective monocentrique.

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SERMENT D'HIPPOCRATE

En présence des enseignants et enseignantes
de cette Faculté,
de mes chers condisciples
et selon la tradition d'Hippocrate,
je promets et je jure d'être fidèle aux lois de l'honneur
et de la probité dans l'exercice de la Médecine.

Je donnerai mes soins gratuits aux indigents,
et n'exigerai jamais un salaire au-dessus de mon travail.

Admis(e) dans l'intérieur des maisons, mes yeux
ne verront pas ce qui s'y passe, ma langue taira
les secrets qui me seront confiés et mon état ne servira pas
à corrompre les mœurs ni à favoriser le crime.

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l'instruction que j'ai reçue de leurs parents.

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TITRE

Comparaison de la qualité d'image et de la dose en scanner thoracique pédiatrique avec et sans filtre étain : étude rétrospective monocentrique.

Résumé

Introduction

La réalisation de scanner thoracique en pédiatrie expose à des radiations ionisantes potentiellement nocives. L'utilisation d'un filtre étain pourrait limiter la dose d'exposition. Notre étude a pour objectif d'évaluer la qualité image et la dose de scanners thoraciques pédiatriques sans et avec filtre étain.

Matériel et Méthode

Il s'agit d'une étude comparative rétrospective monocentrique réalisée au CHRU de Tours. Nous avons inclus 39 enfants ayant bénéficié d'un scanner entre octobre 2020 et mai 2024 ayant eu un scanner avec filtre étain (Groupe 1, n= 30 ; Sn140Kvp) et sans filtre étain (Groupe 2, n=27 ; 100kvp). Les doses de radiation ont été mesurées avec le CTDI (mGy) et le DLP (mGy.cm). La qualité d'image a été évaluée de façon qualitative à l'aide d'une échelle de Likert avec un score allant de 1 à 4 par 2 observateurs (un radiologue junior et un sénior). La concordance inter- observateur a été estimée par un coefficient de kappa de Cohen. La qualité d'image a aussi été évaluée de façon quantitative en effectuant une comparaison du rapport signal sur bruit pour différentes structures anatomiques.

Résultats

Les caractéristiques démographiques étaient comparables entre les deux groupes. Il existe dans le groupe 1 (Sn 140kVP) une baisse du CTDI de 33% et du DLP de 37% ($p < 0.05$). Des différences significatives dans l'évaluation subjective de la qualité d'image ont été observées pour plusieurs structures, avec une meilleure qualité perçue dansle groupe 1(Sn140kVp) pour le thymus, l'œsophage et la vascularisation périphérique. Il n'y pas de de différence significative de qualité d'image qualitative entre les 2 groupes pour la trachée, la carène et les bronches distales. Il existe une bonne concordance entre les observateurs (Kappa = 0,8.). Le signal sur bruit (SNR) n'était pas différent entre les 2 groupes, sauf pour l'aorte où le SNR était plus élevé dans le groupe 2 ($p = 0.04$).

Conclusion

L'utilisation d'un filtre étain sur un scanner thoracique réduit de 33% la dose d'exposition tout en conservant une bonne qualité d'image, ce qui représente un intérêt majeur en pédiatrie.

Mots clés

- Radioprotection
- Pédiatrie
- Scanner thoracique
- Protocole scanner
- Filtre étain
- Dosimétrie
- Imagerie diagnostique

TITLE

Comparison of image quality and dose radiation in pediatric chest CT with and without tin filter: a single-center retrospective study.

Abstract

Introduction

Pediatric chest CT scans expose patients to potentially damaging ionizing radiation. The use of a tin filter could limit exposure dose. The aim of our study was to evaluate the image quality and dose of pediatric thoracic scans without and with tin filters.

Material and method

This is a single-center retrospective comparative study carried out at the CHRU de Tours. We included 39 children who underwent CT scans between October 2020 and May 2024 who had scans with a tin filter (Group 1, n= 30; Sn140Kvp) and without a tin filter (Group 2, n=27; 100kvp). Radiation doses were measured with CTDI (mGy) and DLP (mGy.cm). Image quality was assessed qualitatively using a Likert scale with a score ranging from 1 to 4 by 2 observers (a junior and a senior radiologist). Inter-observer agreement was estimated using Cohen's kappa coefficient. Image quality was also assessed quantitatively by comparing the signal-to-noise ratio for different anatomical structures.

Results

Demographic characteristics were comparable between the two groups. Group 1 (Sn 140kVP) showed a 33% decrease in CTDI and a 37% decrease in DLP ($p < 0.05$). Significant differences in subjective assessment of image quality were observed for several structures, with better perceived quality in group 1(Sn140kVp) for the thymus, esophagus and peripheral vasculature. There was no significant difference in qualitative image quality between the 2 groups for the trachea, carina and distal bronchi. There was good inter-observer agreement (Kappa = 0.8). Signal-to-noise ratio (SNR) did not differ between the 2 groups, except for the aorta, where SNR was higher in group 2 ($p = 0.04$).

Conclusion

The use of a tin filter on a thoracic scanner reduces the exposure dose by 33% while maintaining good image quality, which is of major advantage in pediatrics.

Keywords

- Radioprotection
- Pediatric
- Chest CT
- Scanner Protocol
- Tin filter
- Dosimetry
- Diagnostic imaging

Liste des abréviations

CTDI: Computed tomography dose index

DLP: Dose Length Product

CT: Computed Tomography

ROI: Region Of interest

Sn : Tin

Std : Standard

SNR : Signal Noise Ratio

SD : Standard deviation

Mas : Miliampere Second

NRD : Niveaux de Référence Diagnostique

IRSN : Institut de Radioprotection et de Sureté Nucléaire.

Table des matières

Introduction

The growing use of computed tomography (CT) scans has transformed modern medicine, providing accurate diagnosis and monitoring of a large number of diseases. Children are more sensitive to the adverse effects of radiation, so the risks associated with radiation exposure, such as the development of long-term cancers, are all the more concern in this vulnerable population It is well established that exposure to high doses of radiation during childhood is associated with an increased risk of leukemia, brain tumors and other forms of cancer [1] [2]. A cohort study of 11 million Australians showed that the cancer incidence rate was 24% higher in the 680,000 people exposed compared with those not exposed, after adjustment for age, sex and year of birth, with a dose-response effect observed and a 16% increase in cancer risk for each additional scan[3]. Analysis of the updated French CT cohort in 2022 showed statistically significant dose-response relationships for CNS tumors and leukemia[4] In France, the French Institute for Radiological Protection and Nuclear Safety (IRSN) defines the Diagnostic Reference Levels (NRD) in radiology. These are reference radiation dose values used to optimize practices and ensure that doses administered during radiological examinations are as low as possible, while maintaining image quality. These are shown in annexes document. Chest CT scans in children are used for a variety of indications, including evaluation of persistent respiratory infections, diagnosis and follow-up of congenital lung anomalies, assessment of thoracic masses and severe trauma. In view of this fact, the reduction of radiation doses from CT scans in children became a crucial issue, in the medical community Many research studies are ongoing to develop techniques and protocols aimed at reducing radiation doses while maintaining diagnostic accuracy, such as advanced image reconstruction[5] [6], automatic[7] or organ based tube-current modulation [8–10] or low-energy protocol. The tin filter is a device used in CT scanning to eliminate unwanted photons, optimizing the energy spectrum to reduce dose and improve image quality. It makes a major impact in osteoarticular imaging[11], for example, by reducing hardening artifacts, in urinary lithiasis imaging[12] or in pediatric radiology[13].

The aim of this study was to compare Chest CT with a tin-filter optimized protocol versus a standard protocol in the pediatric population through the evaluation of radiation dose and image quality.

Materials and methods

StudyGroups Population

This was a unicentric retrospective study based at the CHRU Clocheville in Tours. The study was approved by the institutional ethics committee. From October 2020 to May 2024, we included 42 children, between 10 and 50 kg who had a chest CT scan without injection of contrast. Inclusion criteria were having had a chest CT scan without injection and a body weight between 10 and 50kg. Three scans were excluded 1 as incomplete 2 because of an other protocol. after exclusion we had a cohort of 39 patients. To compare image quality and radiation dose between the optimized protocol with tin filtter (Sn140 kVp) and the standard protocol (100kVp), we set up 2 groups with 30 scans in group 1 (Sn140kVp) and 27 scans in group 2 (100kVp), matching groups by weight band. Twelve patients received a 140 kVp protocol scanner with tin filtering ,10 patients were scanned with a standard 100kVp protocol, 17 patients scanned with both protocols. The main clinical indications included initial or follow-up examinations for congenital bronchopulmonary disease (n=54), follow-up of neoplasia (n=2) or search for an infectious focus (n=1). A Bhalla score (shown in figure 1) and a pleural effusion test were performed for each scan.

Scanner protocols

All scans were performed on a 2nd generation CT system (SOMATOM EDGE Definition; Siemens Heathineers, Forchheim, Germany). Table 1 summarizes the CT acquisition characteristics of Groups 1 and 2. Acquisitions were obtained craniocaudally, with or without sedation, and after deep inspiration whenever possible. Automatic modulation of the anatomical tube current was activated.

Category	Scores			
	0	1	2	3
Severity of bronchiectasis	Absent	Mild	Moderate	Severe
Peribronchial thickening	Absent	Mild	Moderate	Severe
Extent of bronchiectasis (no. of segments)	Absent	1–5	6–9	>9
Extent of mucus plugging (no. of segments)	Absent	1–5	6–9	>9
Sacculatoins or abscesses (no. of segments)	Absent	1–5	6–9	>9
Generation of bronchial divisions involved (bronchiectasis/plugging)	Absent	Up to 4th generation	Up to 5th generation	Up to 6th generation and distal
No. of bullae	Absent	Unilateral (not > 4)	Bilateral (not > 4)	>4
Emphysema (no. of segments)	Absent	1–5	>5	
Collapse/consolidation	Absent	Subsegmental	Segmental/lobar	

Figure 1 Bhalla score Template [14]

Acquisition parameters	**Group 1 (Sn140kVp)**	**Group 2 (100kVp)**
kV	140	100
Mas ref.	1037	90
Rotation Time (s)	0,33	0,33
Collimation	128*0,6/1mm	128*0,6/1mm
Slice thickness	1 mm	1 mm
Detector rows	64	64
Pitch	1,4	1,4
Image reconstruction	ADMIRE 3	ADMIRE 3
Kernel	Mediastina Br 38 Parenchyma Bl 57	Mediastina Br 38 Parenchyma Bl 57

Table 1 Scanner acquisition parameters

Radiation dose

CT dose volume index (CTDI) values were documented in the CT system dose report for each study. The dose-length product (DLP), also obtained from the CT system, was used to estimate the individual radiation dose.

Image Quality

All images were evaluated on a dedicated image processing workstation (SYNGO CL Siemens Healthineers) Objective and subjective image quality were assessed by two interpreters a junior radiologist with 4 years' experience and a senior radiologist with 15 years' experience.

Evaluations were performed in both lung window setting (-599; 1600) and soft tissue window (60; 360).

Quantitative evaluation

To measure objective image quality, we inspired from a previous study[15] and placed six different regions of interest (ROIs) with a similar size of 50mm2 in identical positions for all examinations. ROI's positions were in lung tissue (avoiding large blood vessels and bronchi) in the right upper lobe air in the trachea (directly on top of the carina), bone (T4 vertebral body), background air (i.e. outside the body, about 2 cm from the skin adjacent to the right mamelon), descending aorta (directly under the left subclavian artery), and muscular tissue (left paravertebral musculature). In all these ROIs, we used as image noise settings: the mean attenuation values in Hounsfield units (HU) and the standard deviation of the value of the identical ROI. The average attenuation was then divided by the noise of the identical ROI to calculate the signal-to-noise ratio (SNR). High signal-to-noise ratio means good image quality. Examples of this measurement are shown in Figure 2.

Qualitative evaluation

Both radiologists rated normal lung structures. Each individual structure was scored using a four-point Likert scale; 1: no image noise with clear delimitation of the structure, 2: low image noise responsible for light blur of the structure, 3: moderate image noise responsible for moderate blur of the structure, which may cause interpretation difficulties, 4: high image noise and blurring, making it impossible to analyze the structure. For the mediastinal area, the readers evaluated four structures the thymus, the trachea and adjacent ganglion station at the level, the carina and adjacent lymph node stations the esophagus. The mean value of individual scores for mediastinal images was calculated. For the parenchyma, readers assessed four anatomical structures; pulmonary scissures, proximal bronchi and adjacent pulmonary vessels (i.e., structures down to the subsegmental level), peripheral bronchi and adjacent pulmonary vessels (i.e. structures beyond the subsegmental level), peripheral vascular structures within 10 mm of the pleura.

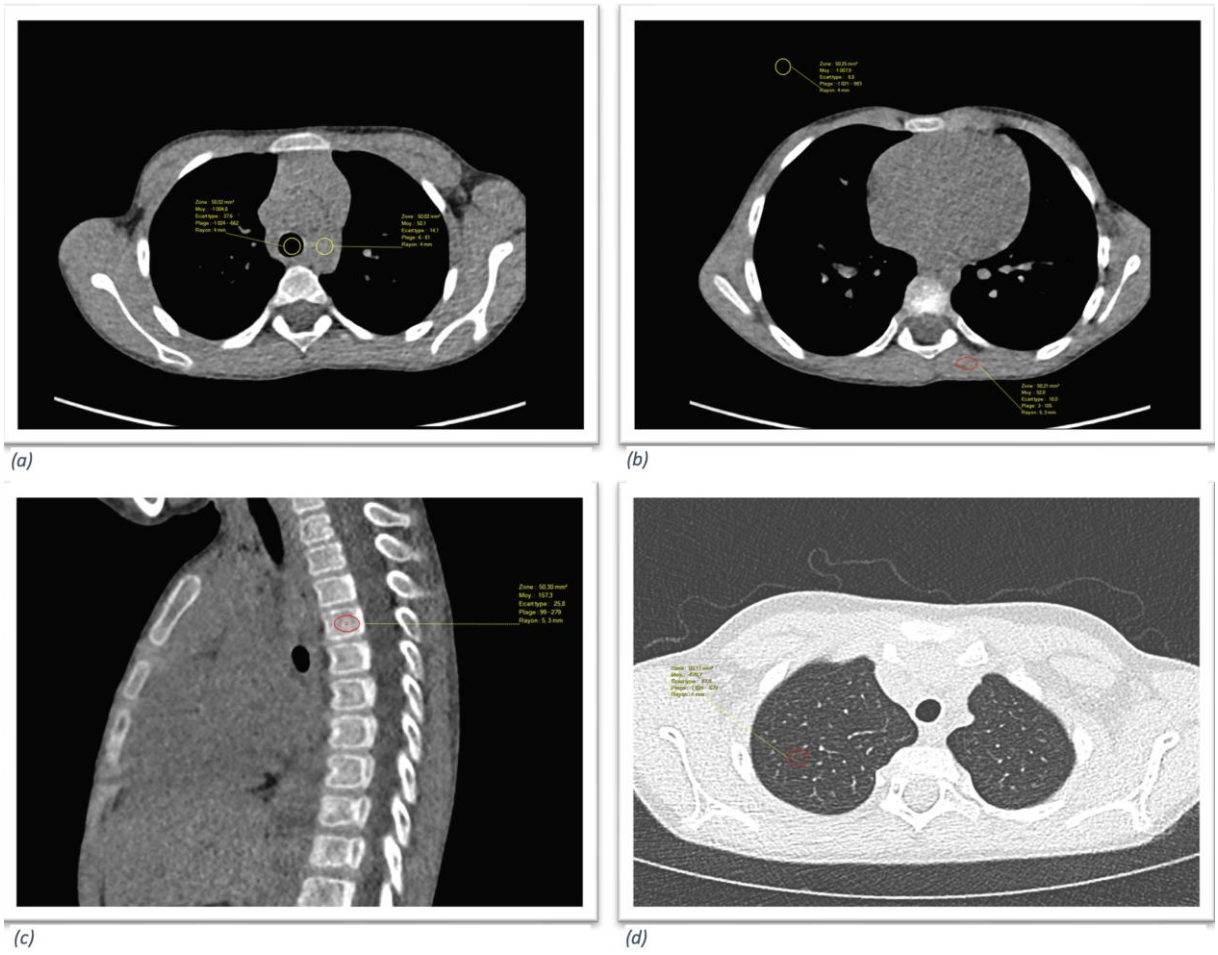

Figure 2 : Examples of ROI's positions, trachea and aorta shown in picture (a), muscle and air in picture (b), bone in picture (c) lung in picture (d)

Statistical analysis

Data were analyzed using Python software, integrating the panda's libraries for data manipulation and SciPy for statistic tests. For demographics independent t-tests were performed for these continuous variables, after verifying the conditions of normality and homogeneity of variances. Independent t-tests (Student's t-test) were used to compare mean radiation doses between the two groups. The hypotheses of normality and homogeneity of variances were tested using the Shapiro-Wilk and Levene tests respectively. Qualitative image quality was assessed by two observers, inter-judge concordance was determined using Cohen's kappa coefficient for each structure, with values interpreted according to standard cut-off points: <0.40 (poor concordance), 0.40-0.75 (moderate to good concordance), and >0.75 (excellent concordance). To compare qualitative assessments between the two groups, the Mann-Whitney U test was used, given the ordinal nature of the data. Differences in SNR between were calculated using

independent t-tests, after transforming the data to normalize the distributions if necessary. A p-value of < 0.05 was considered statistically significant.

RESULTS

Population

The two groups were demographically comparable. The p-values for all demographic characteristics (age, height, weight, and BMI) were well above the standard cut-off of 0.05, suggesting that there were no statistically significant differences between the groups for these variables. The Bhalla scores in Group 1 (Sn 140kVp) was 20.8 and in the group 2 (100kVp) 20.4. The t-test results for comparing the Bhalla scores between the two groups were as follows: t-statistic: 0.404 and p-value: 0.688 suggesting that there was no difference between the groups indicating similar disease severity or lung condition. No pleural effusion was found in each group.

Variable (Mean, SD)	**Group 1 (Sn140kVp)**	**Group 2 (100kVp)**	**Test t / p- value**
Age	7.42 years (± 4.16 years)	8.26 years (± 3.70 years)	-0.81/ 0.42
Height	1.24 m (± 0.22 m)	1.26 m (± 0.21 m)	-0.25 /0.81
Weight	25.51 kg (± 10.50 kg)	26.26 kg (± 9.47 kg)	-0.28 /0.78
BMI	16.00 (± 2.41)	16.15 (± 1.44)	-0.29 / 0.77
Gender Distribution	Girls: 18, Boys: 12	Girls: 15, Boys: 12	

Table 2 Patients characteristics

Radiation dose

The mean CTDI value was 0.89 mGy.cm in the Group 1 and 1.33 mGy.cm in the Group 2 representing a reduction of 33% (p =0.000709) The mean value of the dose-length product (DLP) was significantly lower in the group 1 with a mean measured at 24,03 mGy.cm than in the group 2 at 38.20mGy wich mean a reduction of 37% (p =0.000023). The boxplot (figures 3 and 4) showed that the Group 1(Sn140kVp) with tin filter had a lower median and a more concentrated distribution of values than the Group 2 without tin filter (100kVp). It was similarly the same for DLP (Dose-Length Product) which was significantly lower in the tin filter group.

Dose	Group 1 (Sn140kVp)	Group 2 (100kVp)	t-statistic / p-value
CTDI (mGy)	0.89 (± 0.21)	1.33 (± 0.43)	-4.85 / 0.000023
DLP (mGycm)	24.03 (± 8.52)	38.20 (± 18.16)	-3.70 / 0.000709

Table 3 Doses radiations comparaison with test T student

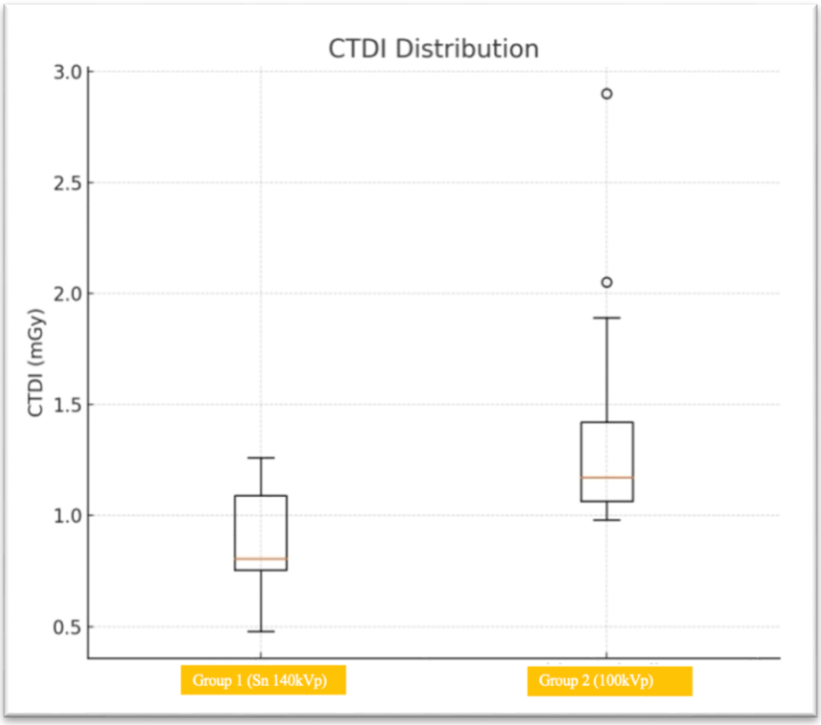

Figure 3 CTDI Distribution in group 1(Sn140kVp) and group 2(100kVp)

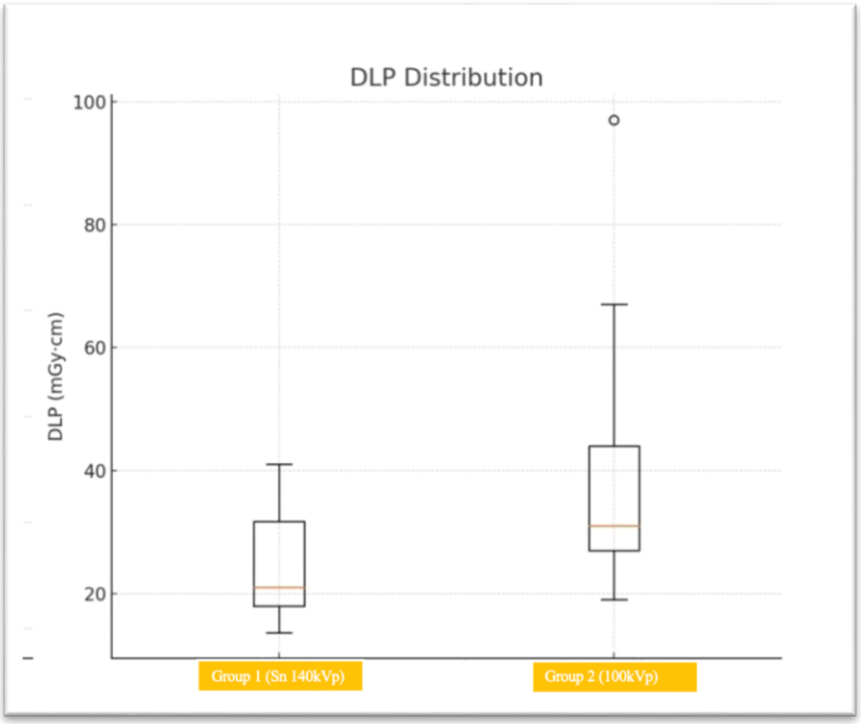

Figure 4 DLP Distribution in group 1(Sn140kVp) and group 2(100kVp)

Image quality

Qualitative evaluation

There was a significant difference in the quality of image for the thymus with a better score in Group 1 (Sn140kvp) a mean score at 1.50 vs 1.93 (p=0.005626) for observer 1 and a mean score at 1.37 vs 1.89 (p=0.000988) for observer 2. There was also a significant difference for both observers in the assessment of the esophagus and distal bronchial vascularization, with a better score in group 1 (Sn140kVp). Observer 1 noted a significant difference for proximal bronchi with a higher mean score in group 2 (100kVp) 1.00 vs 1.23 (p= 0.008236). Observer 2 reported a significant difference for scissure structures, with a higher score in group 2 (100kVp) (p = 0.017725). There was no significant difference in image quality in the 2 groups and by the 2 observers for the trachea, carina, and distal bronchi. Figure 6 shows two scans from the same patient, the first using the standard protocol (100kVp) with a CTDI of 0.98mGy, and the second using the optimized tin-filter protocol (Sn 140kVp) with a CTDI of 0.77mGy. Figure 7 shows chest CT images of two patients with the same characteristics (weight, height, age) in the 2 different groups.

Structure	Group 1(Sn140kVp)	Group 2 (100kVp)	U-statistic	p-value
Thymus	1.50	1.93	255.0	0.005626
Trachea	1.17	1.11	440.0	0.332672
Carina	1.40	1.59	336.0	0.209050
Esophagus	1.83	2.19	282.5	0.013463
Fissures	1.53	1.74	331.5	0.186397
Proximal bronchi	1.23	1.00	499.5	0.008236
Peripheral bronchi	1.83	1.78	423.0	0.753004
Peripheral vascular	1.90	2.09	314.0	0.035404

Table 4 Likert score for the Observer 1

Structure	Group 1 (Sn140kVp)	Group 2 (100kVp)	U-statistic	p-value
Thymus	1.37	1.89	222.0	0.000988
Trachea	1.30	1.07	507.0	0.23974
Carina	1.47	1.59	362.0	0.436848
Esophagus	1.83	2.19	282.5	0.013463
Fissures	1.37	1.70	274.0	0.017725
Proximal bronchi	1.23	1.07	469.5	0.105389
Peripheral bronchi	1.80	1.74	427.5	0.691499
Peripheral vascular	1.87	2.15	301.0	0.012457

Table 5 Likert score for the observer 2

Inter-observer agreement

For most structures, inter-observer agreement was excellent, particularly for vascularization (k=0.945), peripheral bronchi (k=0.876) and carina (k=0.864). For the trachea, agreement was moderate but still acceptable (k=0.52). The mean kappa coefficient was 0.793, indicating good agreement between observers as shown in table 6.

Structure	Cohen Kappa
Thymus	0.773
Trachea	0.527
Carina	0.864
Esophagus	0.842
Scissures	0.806
Proximal Bronchi	0.710
Peripheral Bronchi	0.876
Peripheral vascular	0.945
Mean	0,793

Table 6 Inter observer agreement between the 2 observers with cohen kappa

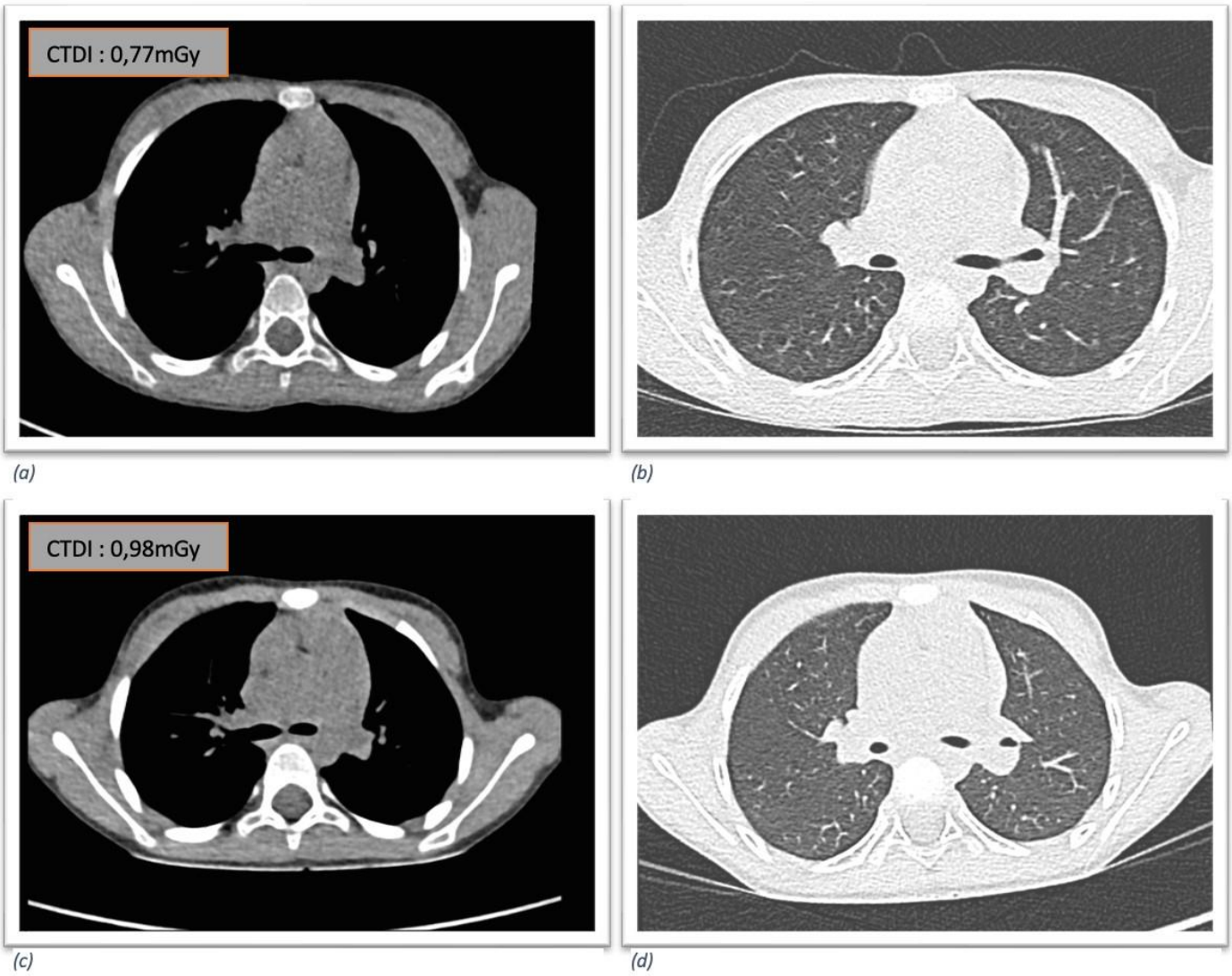

Figure 5 Examples of images for the same patient with two different protocols

(a) (b) Chest CT with a protocol (Sn140kVp) in group 1 CTDI = 0,77mGy

(c) (d) Chest CT standard protocol (100kVp) in group 2 CTDI = 0,98mGy

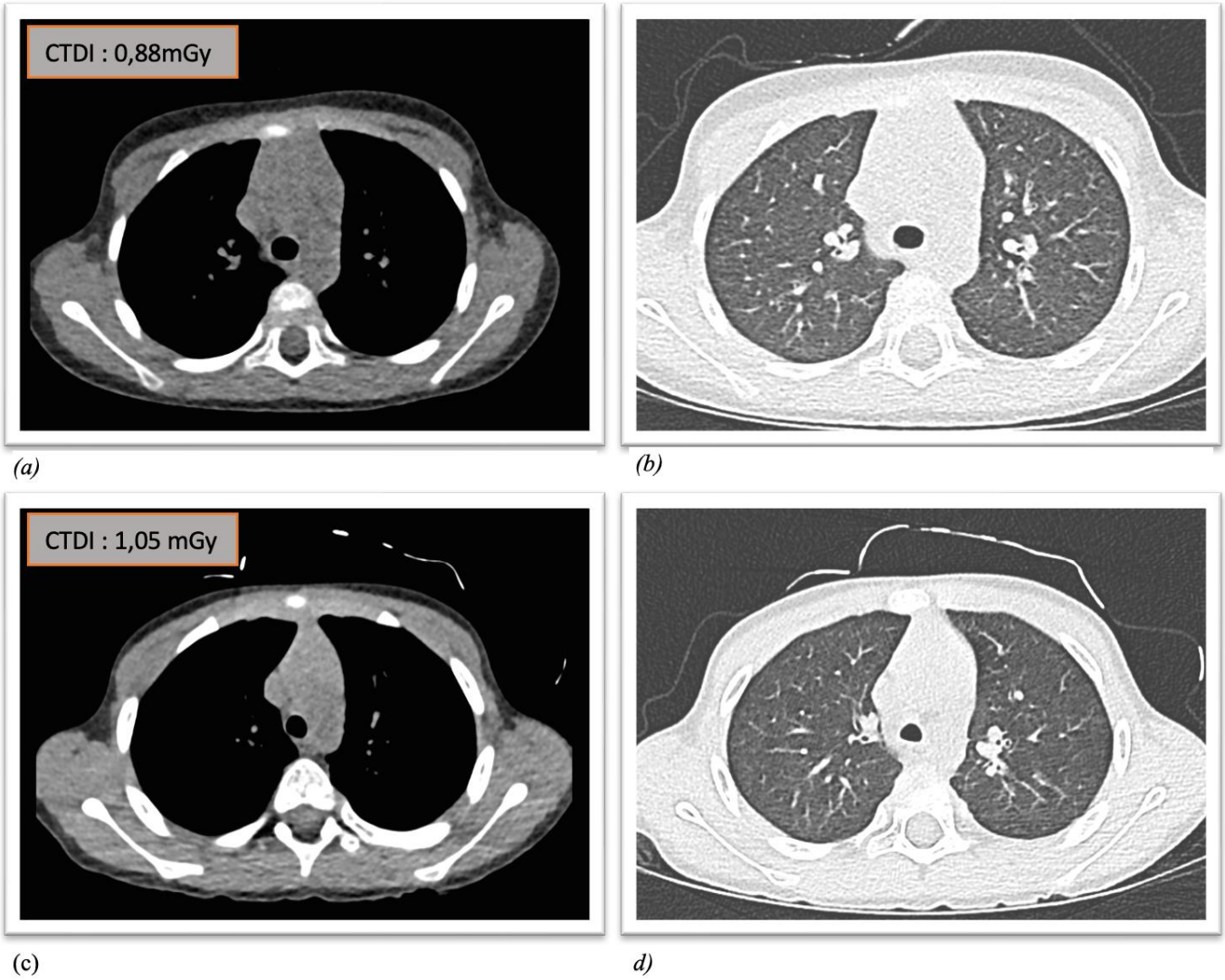

Figure 6 Chest CT of 2 patients with the same characteristics in Group 1(Sn 140kVp) and Group 2(100kVp)
(a) and (b) Chest CT for a 3y's patient, 0,96m 15kg BMI 16,2 with (Sn140kVp) protocol. CTDI = 0,88mGy
(c) and (d) Chest CT for a patient of 4 years: 0,97m 15kg BMI 16. with standard protocol (100kVp) CTDI =1,05mGy

Quantitative evaluation

For the objective evaluation of the image quality, there was no significant difference between the 2 groups except for the aorta, where in group 2 (100kVp) the SNR was higher at 3.21 vs. 2.75 in group 1 (Sn140kVp) ($p = 0.04$).

Structure	Group 1 (Sn140kVp) SNR mean	Group 2 (100kVP) SNR mean	t-statistic	p-value
Air	114.97	107.75	0.899	0.373
Trachea	31.44	35.31	-0.449	0.655
Bone	6.79	6.31	0.839	0.406
Lung	11.05	9.7	1.468	0.148
Muscle	3.63	3.84	-0.655	0.515
Aorta	2.75	3.21	-2.115	0.04

Table 7 For each structure the mean SNR in group 1 (sn140kVp) and group 2 (100kvp)

DISCUSSION

This study illustrates that the use of a tin filter in pediatric thoracic CT protocols significantly reduced radiation dose by 33% while maintaining acceptable image quality for diagnosis. Subjective analysis of image quality demonstrated significant differences between the two protocols for certain anatomical structures. Quality scores for the thymus and esophagus were significantly better with the tin filtration protocol, which could be attributed to better attenuation of hardening artifacts. The use of the tin filter to reduce artifacts was one of the main issues being studied in other conventional and interventional imaging studies as Zhang et al.[16] which investigated the combination of IMAR and tin filter to reduce dose and artifacts for scan-guided lung biopsies. An optimized tin filtration protocol not only reduced the dose, but could also have improved the visibility of certain delicate structures, which was a significant clinical advantage. In addition, it may be noted that for proximal bronchi or fissures the standard protocol obtained better scores by either observer, which may suggest that, although the optimized protocol with tin filter is generally superior or equivalent in terms of image quality, there may be specific cases where a standard protocol may be preferable. As regards the objective analysis of image quality, a significant difference was observed in the SNR measured in the aorta, which was higher in the standard group, this can be explained by a loss of global contrast in vascular tissues, as low-energy photons are suppressed. Several previous studies in many sectors have demonstrated the effectiveness of tin filters in reducing radiation dose while preserving acceptable image quality such as osteoarticular imaging (Park et al[17] which shows a reduction in artefacts for dual-energy ankle scans), in cardiology to reduce the dose for calcium scoring Zook & al.[18] , or for low-dose abdomino-pelvic CT scans to detect urinary stones Zhang et al.[12] .Wressnegger & al [19] have shown that the combination of the 150 kVp tin-filtered thoracic CT protocol with ADMIRE provided a significant dose reduction while maintaining highly diagnostic image quality in follow-up after lung transplantation, compared with a standard thoracic CT protocol using filtered back-projection. Many research have also explored the tin filter in association with spectral filtration, such as the prospective study of Haubenreisser &al [20] which found a 90% dose reduction on a 3rd generation scanner by

combining spectral shaping with tin filtration compared to a standard 2nd generation scanner. This study of 44 colorectal cancer patients showed a dose reduction of 89% for spectral shaping CT with a tin filter vs. standard CT with comparable diagnostic performance Kimura and al .[21] For pediatric radiology, Zhou et al. [22] studied dose reduction for non-injected sinus scans in a pediatric population vs. Phantom. This retrospective study from Siegel et al.[23] on 55 children showed a reduction in dose while maintaining image quality in non-contrast pediatric chest CT for a protocol Sn100kVp with ADMIRE versus an automated kVp selection and filtered back projection (FBP) protocol. The mean CT volume index was 0.83 ± 0.18 mGy for Sn100kVp to (2.17 ± 1.10 mGy in the other group. In our study the mean CT index 0.89 (± 0.21) mGy which seems similar. Weis et al [24] have shown the value of using the 100kVp tin filter in combination with spectral shaping by significantly reducing radiation dose compared, and improving subjective image quality in chest CT for children. At the same dose of radiation, Vivier & al [15] showed a 21.6% reduction in noise with a 100kVp tin filter protocol vs. a 70 kVp protocol. In our study, the dose reduction was 33% with equivalent image quality, which is in line with all the studies we have found in the literature on adults and children, supporting the advantages of a tin-filter protocol in the pediatric population. Using the pediatric diagnostic reference levels (attached), the reference standards for Chest CT for children between 10 and 20 kg and between 20 and 30 kg are 1.3 and 1.4 mGy respectively. In our study for the tin filter group, the CTDI was 0.89mGy, well below the radioprotection objective.

The retrospective, single-center nature of the study may limit the applicability of the results. Practices and equipment may vary from one center to another, which could influence the results if the study were reproduced in another setting. In addition, despite the sufficient sample size of 42 patients for statistical analyses, a larger size would have enabled a more detailed exploration of subtle differences between protocols, particularly for structures where image quality scores were close. Also, the study focused only on children with a weight between 10 and 50 kg, which excludes parts of the pediatric population, such as very young children or heavier adolescents. The results may therefore not be applicable to all pediatric patients. Subjective assessment of image quality, although conducted by experienced radiologists, remains susceptible to inter-observer variability, even though this variability has been measured and found to be acceptable. It's interesting to note that despite the fact that our protocol required us to raise the kilovolts to 140 with the tin filter, which represents a bias for our study in the

comparison with the 100kv protocol, particularly in the interpretation of image quality and noise assessment, we still achieved a dose reduction in the tin filter group. Finally, we did not calculate the effective dose in Sievert, which would have enabled us to make comparisons with other imaging modalities. For further exploration, we could carry out a multicenter study with a larger sample size to confirm these results and assess the reproducibility of the filter's benefits in a variety of clinical contexts. Further research could focus on optimizing the protocols for other types of pediatric pathology, or even exploring the efficacy of this protocol in adults. Reducing radiation dose is a major objective in medical imaging for children, due to their higher susceptibility to the adverse effects of radiation, including the increased risk of developing cancers in the long term. Use of the Sn protocol could therefore become standard practice in pediatric radiology departments, particularly for follow-up examinations where repeated exposure to radiation is required.

Conclusion

Our study shows that the use of a tin filter in pediatric chest CT protocols can significantly reduce radiation dose while preserving good diagnostic image Quality. These results support the idea of introducing this protocol as a standard of care for thoracic CT in pediatric patients, with the prospective of increasing patient safety without comprising diagnostic efficiency.

We used ChatGPT, an OpenAI language model based on the GPT-4o architecture, for additional statistical analysis and English language editing of the manuscript. The authors retain full responsibility for the content.

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Table des figures

Table des tableaux

NRD pour les actes de scanographie, pour une acquisition unique

ACTES	POIDS* (kg)	AGE INDICATIF	NRD IDSV (mGy)	NRD PDL (mGy.cm)
Encéphale	[0 - 10[	0 - 1 an	20	320
Encéphale	[10 - 20[	1 an - 5 ans	22	360
Encéphale	[20 - 30[	5 ans - 10 ans	26	470
Rochers	[10 - 20[	1 an - 5 ans	43	240
Rochers	[20 - 30[	5 ans - 10 ans	51	330
Thorax	[0 - 10[	0 - 1 an	1,1	20
Thorax	[10 - 20[	1 an - 5 ans	1,3	26
Thorax	[20 - 30[	5 ans - 10 ans	1,4	40
Abdomen-pelvis	[10 - 20[	1 an - 5 ans	2	65
Abdomen-pelvis	[20 - 30[	5 ans - 10 ans	2,5	95
Abdomen-pelvis	[30 - 50[	10 ans - 18 ans	4	180

Niveaux de Références Diagnostiques pour les actes de scanographie.

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ZYLBERSZTEJN Carla

40 pages 7 tableaux 6 figures

Résumé :

Introduction La réalisation de scanner thoracique en pédiatrie expose à des radiations ionisantes potentiellement nocives. L'utilisation d'un filtre étain pourrait limiter la dose d'exposition. Notre étude a pour objectif d'évaluer la qualité image et la dose de scanners thoraciques pédiatriques sans et avec filtre étain. **Matériel et Méthode** Il s'agit d'une étude comparative rétrospective monocentrique réalisée au CHRU de Tours. Nous avons inclus 39 enfants ayant bénéficié d'un scanner entre octobre 2020 et mai 2024 ayant eu un scanner avec filtre étain (Groupe 1, n= 30 ; Sn140Kvp) et sans filtre étain (Groupe 2, n=27 ; 100kvp). Les doses de radiation ont été mesurées avec le CTDI (mGy) et le DLP (mGy.cm). La qualité d'image a été évaluée de façon qualitative à l'aide d'une échelle de Likert avec un score allant de 1 à 4 par 2 observateurs (un radiologue junior et un sénior). La concordance inter- observateur a été estimée par un coefficient de kappa de Cohen. La qualité d'image a aussi été évaluée de façon quantitative en effectuant une comparaison du rapport signal sur bruit pour différentes structures anatomiques. **Résultats** Les caractéristiques démographiques étaient comparables entre les deux groupes. Il existe dans le groupe 1 (Sn 140kVp) une baisse du CTDI de 33% et du DLP de 37% ($p < 0.05$). Des différences significatives dans l'évaluation subjective de la qualité d'image ont été observées pour plusieurs structures, avec une meilleure qualité perçue dansle groupe 1(Sn140kVp) pour le thymus, l'œsophage et la vascularisation périphérique. Il n'y pas de de différence significative de qualité d'image qualitative entre les 2 groupes pour la trachée, la carène et les bronches distales. Il existe une bonne concordance entre les observateurs (Kappa = 0,8.). Le signal sur bruit (SNR) n'était pas différent entre les 2 groupes, sauf pour l'aorte où le SNR était plus élevé dans le groupe 2 ($p = 0.04$).

Conclusion L'utilisation d'un filtre étain sur un scanner thoracique réduit de 33% la dose d'exposition tout en conservant unebonne qualité d'image, ce qui représente un intérêt majeur en pédiatrie.

Mots clés : Radioprotection, Pédiatrie, Scanner thoracique, Protocole Scanner, Filtre étain Dosimétrie, Imagerie diagnostique

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