Assessment of Knowledge and Practices of Quality Assurance Test for Computer Tomography among Radiographer in North - West of Nigeria

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Abstract

Background: Quality assurance tests for Computed Tomography (CT) scanners are the operational techniques and activities performed on the CT scanner to certify an optimum operational condition for providing the required diagnostic information at the least exposure to ionizing radiation. Computed Tomography units have recently been introduced into the healthcare system in the north-west Nigeria and their appropriate care and application by staff is yet to be investigated.

Study Aim: The study aims at assessing the knowledge and practices of quality assurance tests for diagnostics CT scanners among Radiographers in the northwest- of Nigeria. This is to ensure correct usage as higher doses are usually associated with CT.

Methods and Materials: This descriptive, cross-sectional study was conducted in the north-western region of Nigeria from January 2016 to March 2016. Using non-probability, purposive sampling method four states were selected. A structured questionnaire was formulated; using pilot study, the validity and reliability of the measuring tool was tested and informed consent was obtained from each respondent. A total of one hundred and eight respondents were selected and the collected data were analyzed using SPSS version 16 software.

Results: Only 16% (n=15) of the respondent knew the meaning of quality assurance test, 68% (n=64) knew the maintenance test within the limit of Radiographer and only 25.5% (n=24) were familiar of the quality assurance tests within the limit of Radiographers. Only 13.8% (n=13) of the respondents practice CT alignment light tests.

Conclusion: Radiographers in the northwest of Nigeria have poor knowledge and practices of quality control tests for diagnostics CT scanners.

Keywords: Quality control tests, diagnostics CT scanners, northwest of Nigeria.

INTRODUCTION

Introduction

Computed Tomography (CT) scanners create cross-sectional images of the human body with a high radiographic contrast. This is significant in the diagnosis of pathological conditions involving soft tissue[1]. The rapid technological advancement in CT results in increase utilization in clinical practices and the use of the modality often continues to grow; between 1996 and 2010 there was a substantial increase in the use of advanced diagnostic imaging, including approximately a tripling of the use of CT [2]. The disadvantage of the modality is that, it is associated with high radiation dose when compared with conventional radiography and fluoroscopy.

The effective dose for adult CT chest is 7 mSv when compared with adult chest x-ray which is just 0.02 mSv; radiation dose received by patient undergoing CT chest is three hundred fifty times than that received by patient undergoing chest x-ray[3]. The increasing complexity of scanner operation, application and the high radiation dose associated with it requires careful monitoring to ensure that procedures are optimized for diagnostic image quality and patient dose. To accomplish this, it is necessary to ensure quality control tests that are being conducted on the equipment[4].

Quality assurance tests for CT scanners are the operational techniques and activities performed on the CT scanner to certify an optimum operational condition for providing the required diagnostic information at the least possible exposure to ionizing radiation[5]. The installation of a new CT scanner, the equipment acceptance test should be conducted to ensure that the equipment meets the purchase and manufacturer's specifications. The results of the tests should be kept on record throughout the life of the equipment from which the subsequent tests will be compared[6]. Quality assurance tests for CT scanners are categorized into; daily, weekly, monthly, semi-annually and annually. The daily, weekly and monthly quality control tests are within the limits of Radiographer while the semi-annual and annual tests are mostly conducted by medical physicists[7]

In the northwest of Nigeria Radiographers are fully in-charge of diagnostics CT scanners, it is therefore critical for them to have a good knowledge and practices of quality control tests. Should they have a good knowledge and practices of quality control tests on CT scanners as stipulated by international standards will ensure smooth operational performance of the equipment. In the course of conducting quality control tests should one encounter any discrepancy, Medical Physicists or Medical Engineer should be promptly alerted for corrective action before causing major fault with the equipment or affecting the image quality. The study aims at assessing the knowledge and practices of quality control tests for diagnostics CT scanners among Radiographers in the northwest of Nigeria.

Methods and Materials

Descriptive, cross-sectional study design was employed. Using non-probability purposive sampling method, four states out of seven were selected in the northwest of Nigeria. These are the states with functioning CT scanners during the period of the study and the study was conducted from January 2016 to march 2016 and states were named A to D. State A has two Federal Government hospitals and two private radio-diagnostics centers while state B has one state government specialist hospital with functioning CT scanner. State C has a federal government hospital and state D has two Federal Government hospitals and one private radio-diagnostics centers that use CT scanners. All the CT scanners in the selected centers were MDCT scanners. One of the selected states had five functioning CT scanners; Toshiba 164 slice scanner, Two GE 16 slices, Philips 16 slices and GE 4 slice scanner. The second state had three; two GE 4 slices and one Philips 16 slice scanners. The other two states, each had GE 16 slices CT scanner. After intensive literature review structured questionnaire was formulated. A pilot study was conducted to test the validity and reliability of the measuring tool, using Cronbach's alpha reliability test the reliability coefficient was found to be 0.819.

The questionnaire consists of three sections; section A is the demographic information on the respondents, section B contains questions on knowledge of quality control tests while section C is about practices of quality assurance tests among Radiographers. Consent form was attached to every questionnaire to obtain informed consent from the respondents.

Questions under demographic information include; age, state of work, workplace and working experience. Questions asked on knowledge of quality assurance tests include; meaning of quality assurance test, type of maintenance system that is within the limit of Radiographer, quality control tests that are within the limit of Radiographer, quality assurance tests perform by Medical Physicists, daily quality control tests, most important quality assurance test for CT scanner, what checking CT number for water imply, number of regions of interest selected when checking field uniformity and the acceptable values for noise at the center and periphery of phantom image. Furthermore questions on practices of quality assurance tests among Radiographers include; whether CT alignment, image display, tube warm-up and fast calibration, external CT positioning lasers, couch top alignment and positioning accuracy tests are conducted on the equipment.

One hundred and eight questionnaires were distributed to consented Radiographers working in hospitals and centres that have functioning CT scanners at the time of the study. During the first week of data collection; data was collected from the respondents in state A, second week from those working in state B, third week from state C and the last week from state D. The collected data was analyzed using SPSS version 16.0 software. The knowledge of quality control tests of a respondent is assessed as good if the score by the respondent is 50% and above or poor if the score is below 50%. Good or poor practice was also as assessed the same way the knowledge is assessed. Knowledge and practices of quality assurance tests among Radiographers is considered to be good if 50% or more of the respondents score 50% and above, but it will be considered poor if less than 50% of the respondents score 50% and above.

Results

Out of one hundred and eight (100%) distributed questionnaires, ninety-nine (91.7%) were returned and ninety-four (87%) were properly filled. The age of the respondents ranged from 26 to 50 years (mean = 33.2±9.6). The respondents consist of 80.9% (n = 76) males and 19.1% (n = 18) females. Thirty nine percent (n=37) of the respondents were from state A; (n=31) from the two federal government hospitals and the remaining (n=6) from the two-private radio-diagnostics centers. Five percent (n=5) of the respondents were from state B which has only state government specialist hospital with functioning CT scanner. Thirty three percent (n=31) of the

respondents were from state C which has only one federal government hospital with CT scanner. While 22.3% (n=21) of the respondents were from state D which have three federal government hospitals each with a functioning CT scanner. The working experience of the respondents ranged from 0 to 25 years.

Table 1: Percentages of correct answers to questions on knowledge and practices of quality assurance tests for diagnostics CT scanners

Questions	% scores
Meaning of quality tests for CT scanners	16
Maintenance system within the limit of radiographers	68.1
Quality assurance tests within the limit of radiographers	25.5
Quality assurance tests performed by medical physicists	29.8
Daily quality control tests	24.5
Most important test for CT scanners	17
What checking CT number for water imply	57.4
Number of regions of interest selected when checking field uniformity	19.1
Value for noise at the centre and periphery of the phantom image	37.2
CT alignment light test	13.8
Image display test	20.2
Tube warm-up and fast calibration tests	97.9
External CT positioning laser test	14.9
Couch top alignment and positioning accuracy tests	16
Test(s) performed on scanners	11.7

Table 2: Percentages of good knowledge and practices of quality control tests for CT scanners among radiographers

State	Respondents	Knowledge	Practices
A	39.4	2.1	4.3
B	5.3	0	0
C	33	2.2	2.1
D	22.3	2.1	11.3
Total	100	6.4	17.7

Discussion

Daily, weekly and monthly quality assurance tests for diagnostics CT scanners should be conducted by the Radiographers' in-charge of the equipment. The daily quality control tests include; CT number for water, field uniformity, image noise, and artifact evaluation and CT alignment lights[7]. The weekly quality assurance tests include; spatial resolution, low contrast resolution and the density level on the processed cine films tests[7] while the monthly quality control tests are; scan increment accuracy, couch positioning and scan localization light accuracy[7].

These tests are to be conducted by the Radiographers and the results be kept in records for review by Medical Physicists. Moreover Radiographers are in-charge of the equipment therefore good knowledge and practices of quality control tests are critical for successful performance of the equipment. The semi-annual and annual quality control tests should be conducted by Medical Physicists and review all the quality control tests that are being conducted by Radiographers.

The findings of the study shows that only 16% (n=15) of the respondents know the meaning of quality control tests as shown on table 1 above, all Radiographers ought to have known what quality control tests for CT scanners is all about due to increasing clinical application of the equipment. The results of the study revealed that 68% (n=64) of the respondents are aware of the maintenances that is within their limit as indicated on table 1 above. It is critical for Radiographers' in-charge of the CT scanners to know that only preventive maintenance system is within their limit, the corrective maintenance is within the limits of Medical Physicists or Electro-medical Engineers. Only 25.5% (n=24) of Radiographers in-charge of CT scanners in north-western region of Nigeria are familiar with quality control tests that are within their limits as shown on table 1 above.

Most of the respondents don't know their limitation on quality control tests; this simply means they don't perform the testsand if they did, likely perform some that are not within their limit. Once a technique is performed beyond the limit of a professional there is a high tendency of inaccurate results. The findings of the current study shows that only 24.5% (n=23) of the respondents are familiar with the daily quality control as indicated on table 1 above.

Most of the respondents don't know their limitation on quality control tests; this simply means they don't perform the testsand if they did, likely perform some that are not within their limit. Once a technique is performed beyond the limit of a professional there is a high tendency of inaccurate results. The findings of the current study shows that only 24.5% (n=23) of the respondents are familiar with the daily quality control as indicated on table 1 above. Daily quality control tests for CT scanners revealed performance condition; therefore every Radiographer ought to know the daily quality control tests. Fifty seven percent (n=54) of the respondents indicated that they know what checking CT number for water imply as shown on table 1 above. Every quality control test is giving a clue on performance of a particular component of the CT scanner, therefore this will assist the Radiographer in making diagnosis of the part of the scanner that is faulty whenever the results of the test is not in accordance with the standard. Table 1 above shows that only 19.1% (n=18) of the respondents know the number of region of interest to be selected when checking field uniformity on phantom image. This shows that majority of the Radiographers have not been conducting this test on their scanners; being it daily quality control test they would have known it. The results of the study shows that only 37.2% (n=35) of the respondents have knowledge of the acceptable values for noise at the centre and the periphery of the phantom image. The acceptable value at the centre should be 3 and 5 at the periphery. The knowledge is critical because when the results exceed the acceptable limit; the attention of the Medical Physicist or Engineer will be called for corrective action.

Furthermore the findings of the study shows that only 13.8% (n=13) of the respondents practice CT alignment light tests on their scanners as shown on table 1 above. This test is very important in localization of anatomical structure in human body more especially in CT guided biopsy. Therefore since most of the Radiographers did not practice the test to ensure the accuracy of the equipment; there is great tendency to miss-locate anatomical structure during CT guided biopsy. Only 20.2% (n=19) of the respondents practice image display test on their equipment as shown on table 1 above. Once a scanner passed this test there is a great tendency that what the computer compute is what exactly display on the monitor.

The results of the study show that 97.9% (n=92) of the Radiographers in-charge of the CT scanners conduct tube warm-up on their equipment as indicated on table 1 above.

The results of the study show that only 6.4% (n=6) of the respondents have good knowledge of quality control tests for diagnostics CT scanners in north-west of Nigeria as shown on table 2 above. With the increasing number of clinical applications and high radiation dose associated with CT scanners; it is of great concern to know that only six out of ninety-four respondents scored 50% and above on questions of knowledge of quality assurance tests. Smooth operational performance of CT scanners could only be achieved with effective quality assurance practice sand accurate results from quality assurance practices could only be achieve with a good knowledge of quality assurance tests. Furthermore, the findings of the study show that only 17.7% (n=17) of the respondents have a good practices of quality control tests as indicated on table 2 above. This means majority of CT scanners in north-west are not subjected to quality assurance tests in accordance with manufactures instruction. The findings of the study show that Radiographers in state D have better knowledge and practices of quality assurance tests when compared with their colleague in the other states as shown on table 2 above. Respondents in state D constitute 22.3% of the total respondents but have the same percentage of knowledge with states A and C which constitute 39.4% and 33% respectively. The practices of quality tests in state D is by per better than other states; out of the 17.7% of good practices of quality assurance tests in the four states. State D alone has 11.3% of good practices; A with 4.3%, C has 2.1 and B with no respondent that has good quality control practice. The poor knowledge and practices of quality assurance tests for diagnostics CT scanners among Radiographers across north-western region of Nigeria might be due to poor consideration of the subject in the curriculum of Radiography in Nigeria. There were no publications assessing knowledge and practices of quality control tests for diagnostics CT scanners among Radiographers. The only related article online was the study conducted by [8]which shows variability of knowledge among Radiologists and cohort Specialist Radiographers on CT exposure parameters. The findings of the study indicated that both Radiologist and Radiographers have good knowledge of exposure parameters compared to the current study which indicated poor knowledge and practices among Radiographers.

Conclusion

Radiographers in north-west of Nigeria have poor knowledge and practices of quality assurance tests for diagnostic CT scanners. There is therefore the need for curriculum review.

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QUESTIONNAIRE

Instruction

Please answer the following questions by choosing the correct option among the options provided, read each question or statement carefully before answering. Answer truthfully and to the best of your knowledge. All the information will be kept confidential and will only be used for the purpose of this research.

Section A:
Demographic Data of the Respondent

1. Age (years)
   (a)20-29 (b) 30-39 (c) 40-49 (d) 50 & Above

2. Gender
   (a)Male (b) Female

3. State of work
   (a)Jigawa (b) Kaduna (c) Kano (d) Sokoto

4. Work place
   (a)Teaching Hospital (b) Government Specialist

5. Working experience (years)

(a)0-4 (b) 5-9 (c) 10-14 (d) 15-19 (e) 20-24 (f) 25-29

(h) 30-34 (I) 35 & above

Section B:
Knowledge of quality control tests

6. Which of the following best described quality control tests for CT scanners?

(a)Planed and systematic actions that produce high quality images with low exposure to ionizing radiation

(b) Techniques use in testing CT scanners (c) An organized designed to provide quality assurance for CT scanners

7. Which of the maintenance system is within the limit of radiographer?

(a)Corrective maintenance (b) Preventive maintenance

8. Which of the following quality control tests are within the limit of radiographer?

(i) Spatial resolution test (ii) CT number for water
(iii) Field uniformity (iv) Noise
(a) I only (b) 1 and 2 only (c) 1 and 4 only (d) 2, 3 and 4 only

9. The following quality control tests are to be performed by Medical Physicist?

(a)Acceptance test
(ii) Image slice thickness (iii) Dose profile width (iv) Artifacts
(a)1, 2, 3 and 4 (b) 1 and 4 only (c) 1 and 3 only (d) 1 and 2 only

10. Which of the following are daily quality control tests?

(i) Low contrast resolution (ii) High contrast resolution (iii) Noise (iv) Field uniformity
(a) 1 and 4 only (b) 1 and 2 only (c) 3 and 4 only
(d) 1, 2 and 3 only

11. Which of the following test is the most important for CT scanners?

(a)CT number for water (b) Low contrast resolution
(c) High contrast resolution (d) Noise

12. Checking CT number for water is the same as?

(a)Checking the algorithms computing CT number across the image
(b) Checking the performance of the detectors
(c) Performance of digital-analog converter

13. When checking field uniformity how many regions of interest are selected?

(a)1 (b) 2 (c) 3 (d) 4 (e) 5

14. The acceptable values for noise at the center and periphery of the phantom image are?

(a)3 and 5 (b) 3 and 6 (c) 2 and 4 (d) 5 and 3

Section C
Practices of quality control tests among radiographers

15. Do you perform CT alignment lights test?

(a)Yes [ ]   (b) No [ ]

16. Do you perform image display test?

(a) Yes [   ]   (b) No [   ]

17. Do you perform tube warm-up and air calibration test?

(a) Yes [ ]   (b) No [ ]

18. Do you perform external CT positioning lasers test?

(a) Yes [ ]   (b) No [ ]

19. Do you perform couch top alignment and positioning accuracy test?

(a)Yes [ ]   (b) No [ ]

20. Which of the following test(s) do you perform on your scanner?

(I) CT number accuracy (ii) Field uniformity (iii) Noise
(iv) Artifacts
(a) 1 and 2 only (b) 1, 2, 3 and 4 (c) 1, 2 and 3 only
(d) None of the above

Thank you